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Announcement of Opportunity

Magnetospheric Multiscale Mission (MMS)

Notices of Intent Due:
Proposals Due:

**January 31, 2003
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THE MAGNETOSPHERIC MULTISCALE MISSION

1.0 DESCRIPTION OF THE OPPORTUNITY

1.1 Programmatic Background

The Magnetospheric Multiscale Mission (MMS) is the fourth Solar Terrestrial Probe program of the National Aeronautics and Space Administration (NASA). The Solar Terrestrial Probe (STP) Program is managed by the Sun-Earth Connection Division of the Office of Space Science (OSS) within NASA. The STP program sponsors the strategic missions required to develop the scientific understanding of the coupled Sun-Earth system consistent with the recommendations of the Sun-Earth Connection Advisory Subcommittee (SECAS) and the Space Science Advisory Committee (SScAC). The STP program also conducts a significant Education and Public Outreach (E/PO) program in collaboration with other Sun-Earth Connection programs such as Living With a Star and the Sun-Earth Connection Education Forum.

1.2 Scientific Objectives

The scientific objectives of the MMS mission are to explore and understand the fundamental plasma physics processes of, primarily, magnetic reconnection, and secondarily, particle acceleration and turbulence, on both the micro- and mesoscales in the Earth's magnetosphere (see additional details in Section 2 of this Announcement of Opportunity (AO)). To accomplish these objectives, this AO solicits Instrument Suite Science Team (ISST) proposals to provide complete scientific research investigations that include all of the following elements:

- design, development, and delivery to NASA of four suites of flight instruments capable of producing the necessary and sufficient data to address this mission's prime science objectives and, to the maximum extent possible, its secondary objectives as well;
- design and development of hardware and software to support the reduction, calibration, analysis, distribution, and archiving of the data from the flight MMS instrument suites;
- active participation in mission integration, mission operations, and data acquisition;
- development and implementation of MMS science operations;
- reduction, analysis, distribution, and preparation for archiving of calibrated MMS instrument data;
- participation in the definition of MMS Mission Level Data products;
- analysis and timely publication of research based on the integrated data sets from MMS that address the objectives described in Section 2 of this AO; and
- planning and implementation of an integrated MMS Education and Public Outreach (E/PO) effort.

A Science and Technology Definition Team (STDT) sponsored by NASA has defined a focused set of scientific objectives for the MMS mission and recommended a strawman suite of instruments that would be sufficient to acquire the data for those science objectives (see Appendix C for information on how to access the MMS STDT Report). This MMS STDT stressed that

solving the problems addressed by the MMS mission will require a synergistic use of the instruments; therefore, MMS ISST investigations proposed in response to this AO will have to demonstrate how they plan to use the measurements obtained by the instrument suite to address the science objectives.

1.3 Available NASA Resources

Proposing organizations must recognize that NASA's resources available for this program are cost constrained and propose accordingly. As a guideline, the total cost to NASA of the ISST investigation selected through this AO from Phase A through Phase E (see definitions of Phases in Section 1.4) is capped at approximately \$90M in real year dollars, including proposers' cost reserves. Approximately \$0.75M is reserved for each fixed-price contract for the Phase A and Phase A Bridge study resulting from selection(s) through the AO. In any event, the continuation of any aspect of this program is always contingent upon the availability of appropriate NASA funding through the yearly Federal budget process.

1.4 Overview of Specific Provisions for Proposals

1.4.1 The ISST Investigation

This AO solicits proposals for an ISST scientific investigation led by a single Principal Investigator (PI) and aided by an appropriate and justified number of Co-Investigators (Co-I's; see also Appendix B, Section C.2.d) that provide and/or analyze the data from the proposed instrument suite. The PI must be from a U.S. organization from any category, including educational institutions, industry, nonprofit institutions, or from one of the NASA Centers, the Jet Propulsion Laboratory (JPL), other Federally-funded research and development centers, or other U.S. Government agencies. Other participants in the ISST may come from any combination of institutions, public or private, domestic or foreign including all NASA centers and the Jet Propulsion Laboratory. Participation in the ISST by non-U.S. organizations is welcomed under a no-exchange-of-funds basis.

Proposals submitted in response to this AO must be for complete science investigations, as defined in Section 1.2 that encompass all appropriate mission phases. NASA mission phases, as defined by NASA Procedures and Guidelines (NPG) 7120.5, are Formulation, Approval, Implementation and Evaluation. The ISST shall support the MMS Project in progressing through these phases. For the purposes of this AO, Formulation is divided into the following two phases:

- Phase A – Concept Study: development of a detailed cost proposal for Phases B through E, and a budget for Phase B studies (pending the decision to continue), culminating in a Phase A Report (reference Appendix C for information on Phase A Report requirements);
- Phase B – Definition and Preliminary Design: applying results of mission studies and trades completed in Phase A to generate preliminary designs that satisfy the identified constraints and requirements, culminating in a Preliminary Design Review (PDR);

An MMS Project level review will be held that marks the end of Phase A and the beginning of the transition to Phase B (Mission Definition Review or equivalent). This review must be successfully

completed before a transition from Phase A to Phase B of Formulation can be accomplished through an Initial Confirmation Review with the Associate Administrator (AA) for Space Science. Approval is the process for transitioning into Implementation, which includes the steps leading to a Confirmation Review with the AA for Space Science. The ISST shall support the MMS Project in both of these reviews. Implementation is divided into the following phases:

- Phase C – Design and Development: completion of detailed design, procurement, and hardware and software component development. A Critical Design Review (CDR) takes place early in the Phase;
- Phase D – Integration, Test, and Launch Operations: integration of hardware components and the functional and environmental testing necessary to verify the design and development (nominally January 2009 through launch plus 90 days); and
- Phase E – Mission Operations (through two years after launch plus 90 days) and Data Analysis (three years after launch plus 90 days): provision of data for public use, analysis, and publication in the peer-reviewed scientific literature, and delivery of the reduced, calibrated data to a NASA-specified data archive.

The Evaluation process is not a separate phase, but is the ongoing independent review and assessment of the overall MMS Project's status during both Formulation and Implementation.

Note that the planning, design, and implementation of an appropriate E/PO program is expected to be an integral element of the investigation during all mission phases (see Section 5.5).

Proposers to this AO must estimate the Total NASA Cost, defined, as all costs necessary to complete the investigation from Phase A through Phase E, including reserves. The total cost to NASA for all investigations, including reserves, for this mission cannot exceed the NASA budget for this mission. The budget profile guideline is given in Table 1.1 by Fiscal Year (FY) in real year millions of dollars assuming a launch readiness date of June 2008.

Table 1.1. Funding profile of the Magnetospheric Multiscale Mission in Real Year \$M.

Phase A-B		Phase C-D					Phase E		
FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12
0.75	5.5	14.4	20.3	16.7	14.9	8.1	3.5	3.5	2.2

To meet the cost constraint, NASA may descope the ISST investigation either at the time of selection in accordance with the provisions of Section II, Appendix A, of this AO, or at any subsequent phase. As a guideline, a proposal must provide a cost reserve of 20% for Phase C and D and 10% for Phase E. In general, schedule reserve must be approximately four weeks per year for Phases C and D.

Additional elements for the MMS mission not listed in Section 1.2 may be proposed in response to this AO only if the proposal demonstrates that such additions are appropriate and justified and do not displace any of the required elements. Although any additional elements so proposed will not be considered in the evaluation for selection through this AO for Phase A, such elements may be

included in the Phase A Concept Study Report to be considered in the evaluation for approval for Phase B.

The cost proposed for the elements listed in Section 1.2 must be within the cost guideline in Section 1.4, include all Phases B through E, and be given in real year U.S. dollars, including proposers' contingencies. Any additional elements included in the proposal must be costed separately. See Table B-5 in Appendix B for the NASA Inflation Index.

1.4.2 MMS Interdisciplinary Science Investigations

It is the intent of NASA to separately solicit MMS Interdisciplinary Science (IDS) proposals to conduct independent science investigations that address the MMS science objectives. Each IDS PI is expected to form a team to conduct investigations addressing the MMS science objectives independently of the ISST science efforts. The scale of an IDS proposal is expected to be greater than a typical SEC Guest Investigator (GI) or Science Research and Technology (SR&T) proposal. It is expected that several IDS teams will be selected prior to the MMS Phase C/D. During the Phase C/D the IDS PI's will function as members of the MMS Science Working Group (SWG) in an advisory and consultant capacity to the MMS Project and ISST PI on issues relating to MMS science. One of the primary functions of the IDS PI's during the Phase C/D will be to work in concert with the ISST PI to define and develop the MMS Mission Level Data (MLD) products. MLD are those data that are derived from the integrated instrument suite data. This function of the IDS team is in addition to conducting preparatory science investigations that may be proposed in advance of the existence of the MMS data. At the commencement of the MMS Phase E, each IDS PI will become a member of the MMS SWG along with the ISST PI and up to four ISST CoI's that are identified as instrument lead investigators (see further details in section 5.2.2 of this AO).

In order to enable the maximum number of interested parties to propose, it is expected that the IDS solicitation will be offered approximately six months after the selection of the ISST through this AO. ISST CoI's selected through this AO will not be eligible for IDS funding. The IDS funding is separate from the ISST and is not included in the funding profile for the ISST included in this AO. The MMS IDS solicitation will not solicit flight hardware. All applicable information regarding the IDS proposal content, requirements, and guidelines will be described in the IDS proposal solicitation.

1.4.3 MMS Science Working Group

An MMS Science Working Group (SWG) will be established and be composed of the ISST Principal Investigator, four ISST CoI's that are identified as instrument lead investigators (see further details in section 5.2.2 of this AO), and the Interdisciplinary Science (IDS) PI's. It will be established as soon as the IDS PI are selected. The MMS SWG will be chaired by the MMS Project Scientist. The SWG will have the charter to advise the MMS Project Office of mission-level science issues, including refinement of the mission architecture and resolution of any mission-level issues that affect the generation of MMS MLD products. Resolution of any issues internal to the ISST that do not affect MMS MLD products will not be the purview of the MMS SWG. Resolution of any issues that affect MLD products will be the purview of the MMS SWG. The purpose of the SWG will be to maximize the scientific return of this mission within the

existing resources. It is expected that SWG meetings will be conducted at least twice a year beginning in Phase C. Proposers to this AO should include funding to cover travel for reviews and meetings.

1.5 Overview of Selection of Proposals

Pending the submission of proposals of adequate merit, one (or more) proposal(s) submitted in response to this AO will be selected for a funded Phase A study(ies) as based principally on its(their) scientific and technical merit as determined by science peer review as well as its(their) feasibility of implementation as determined by the Technical, Management, and Cost (TMC) panel. The TMC panel will also consider the demonstrated commitment of the proposer to meeting NASA's stated goals for education and public outreach, technology infusion/transfer, and participation of small disadvantaged businesses (SDB), women owned small businesses (WOSB's), Historically Black Colleges and Universities (HBCU's), and other Minority Educational Institutions (MEI's). See Section 7.1 below in this AO for further details.

2.0 ANNOUNCEMENT OBJECTIVES

This AO offers a research opportunity to investigate the fundamental plasma physics process of reconnection, particle acceleration, and turbulence on the micro- and mesoscales in the Earth's magnetosphere. These three processes – which control the flow of mass, energy, and momentum within and across plasma boundaries – occur throughout the universe and are fundamental to the understanding of both astrophysical and solar system plasmas. Thus, it is expected that the science impact of the MMS results will have far-reaching and fundamental impact in other disciplines that study plasma physics beyond that of the Earth's own magnetosphere. The MMS mission is consistent with the NASA Space Science Enterprise Strategic Plan Science Objectives, primarily to understand our changing Sun and its effects throughout the Solar System and learn how galaxies, stars, and planets form, interact, and evolve.

The MMS STDT carefully considered the range of science objectives appropriate for this mission and endorsed the understanding of reconnection as it occurs in the Earth's magnetosphere as the primary science goal for the program. The key questions needed to be answered in order to achieve this science objective are listed in Table 2.1. The questions in Group 1 relate to the primary MMS science objective and are considered the highest priority, whereas the questions in Group 2 are considered of lower priority. For this AO, the questions within each group in Table 2.1 are of equal priority. All proposals must address the Group 1 questions to be considered compliant with this AO.

The MMS STDT report provides additional background information that may be useful to the proposers who seek to respond to this solicitation. It may be accessed through the MSS Library (see Appendix C). It is important to note, however, that this STDT report describes a prototype MMS mission that incorporated five identically instrumented spacecraft (S/C), whereas trade studies of various S/C options conducted by NASA has since indicated that more than four partially-redundant S/C will likely exceed the resources available for this mission. Therefore, the MMS STDT considered this limitation and endorsed the MMS mission with a baseline of only four

identically instrumented, partially-redundant S/C. In case of a conflict between concepts outlined in this AO and those in the STDT report, the provisions of this AO take precedence. In particular, to be considered responsive to this Announcement, proposed investigations must address the objectives described here in Section 2.

Table 2.1. Priorities of the Magnetospheric Multiscale Mission

Group 1 Questions - Highest Priority	
Reconnection	What are the kinetic processes responsible for collisionless magnetic reconnection? How is reconnection initiated?
	Where does reconnection occur at the magnetopause and in the magnetotail, and what influences where it occurs?
	How does reconnection vary with time, and what factors influence its temporal behavior?
	How are flux transfer events and plasmoids/magnetotail flux ropes formed, and how do they evolve?
Group 2 Questions - Secondary Priority	
Particle Acceleration	What is the role of inductive electric fields and wave-particle interactions in high-energy particle acceleration?
	How are particles accelerated in plasma injection events in the near-Earth tail?
	What are the mechanisms for accelerating charged particles at plasma boundaries?
Turbulence	What are the temporal and spatial properties of, and the physical processes responsible for, turbulence in the magnetosheath, magnetopause, and plasma sheet?
	What are the sources, propagation, and consequences of mesoscale boundary waves?
	What is the role of turbulence in plasma entry through the magnetopause?

3.0 BACKGROUND

3.1 Overview

NASA's Sun-Earth Connection (SEC) Division seeks to better understand why the Sun varies; how the Earth and other planets respond; how solar variability affects Earth's climate, life, and society; and how the heliosphere interacts with the galaxy. The Sun is a variable star whose energy output varies on all time scales from seconds to centuries. The Earth, planets, and other bodies reside within the Sun's outward flowing solar wind, consisting of plasma, energetic particles, and

magnetic fields, which is the extension of the Sun's corona whose outer boundary defines the heliosphere. By analyzing the connections between the Sun, solar wind, planetary space environments, and the Galaxy, SEC science works to explain the fundamental physical processes that occur throughout the Universe. These four broad Quests are more fully described in the *Sun-Earth Connection Roadmap: Strategic Planning for 2000-2025* (see Appendix C for access to this and related documents).

The SEC Division science program sponsors missions in two programs: Solar Terrestrial Probes (STP) and Living With a Star (LWS). These two programs complement each other in achieving the goals of the SEC Division and are in addition to the more widely competed Explorer opportunities. MMS will be a mission under the STP Program.

3.2 Solar Terrestrial Probes and Other Relevant Programs

The STP program addresses the full spectrum of SEC goals with a sequence of strategic research missions meant to answer tightly focused science questions such as those meant to be addressed by MMS. STP missions that may operate concurrently with MMS are Solar-B (sponsored jointly by Japan's Institute of Space and Astronautical Science (ISAS), and the Particle Physics and Astronomy Research Council (PPARC) of the United Kingdom), NASA's already approved Solar Terrestrial Relations Observatories (STEREO), and NASA's future Geospace Electrodynamics Connections (GEC) and Magnetospheric Constellation (MagCon) missions. This series of missions provides the major strategic thrust of the Sun-Earth Connections program, the goal of which is to understand solar variability and its influence on the Earth and the other planets. Additional ground-based and space-based programs are also expected to complement the observations provided by MMS, including, but not limited to:

- the Geosynchronous Operational Environmental Satellites (GOES) and National Polar-Orbiting Operational Environmental Satellite System (NPOESS), both sponsored by the National Oceanic and Atmospheric Administration (NOAA);
- the Advanced Composition Explorer (ACE) sponsored by the NASA Explorer program;
- the European Space Agency's (ESA) Cluster mission that carries a NASA-provided investigation;
- the Two Wide-angle Imaging Neutral-atom Spectrometers (TWINS) mission of opportunity sponsored by the NASA Explorer program;
- the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) mission sponsored by the NASA Explorer program;
- the Polar and Wind missions;
- the future LWS Geospace Storm missions

3.3 Programmatic Recommendations

The objectives of the MMS mission are to explore and understand reconnection, particle acceleration, and turbulence on the micro- and mesoscales in the Earth's magnetosphere. Achievement of the MMS mission objectives will allow the determination of how energy, mass, and momentum are transferred within and across plasma boundaries. At the same time, it will clarify greatly how these same processes act in other astrophysical contexts. Specific science

objectives, defined in terms of the key science questions are listed in Section 2. These processes of reconnection, particle acceleration and turbulence are not well understood. Therefore, it is recommended that the MMS mission, under the STP program, fly a suite of instruments like the ones described in this AO, or equivalent, on a constellation of at least four S/C.

4.0 PROPOSAL OPPORTUNITY PERIOD

This Announcement of Opportunity solicits proposals for a single opportunity in accordance with the schedule given in Section 8.

5.0 REQUIREMENTS AND CONSTRAINTS

5.1 Description of the MMS Mission

The MMS mission is expected to employ four identically instrumented S/C, orbiting in a tetrahedral formation, to conduct definitive investigations of magnetic reconnection, and if possible, of charged particle acceleration and turbulence as well in key boundary regions of the Earth's magnetosphere. These three processes – which control the flow of energy, mass, and momentum within and across plasma boundaries – occur throughout the universe and are fundamental to our understanding of astrophysical and solar system plasmas. It is only in the Earth's magnetosphere, however, that they are readily accessible for sustained study through the *in situ* measurement of plasma properties and of the electric and magnetic fields that govern the behavior of the plasmas. Through high-resolution measurements made by each S/C, whose separations can be varied from 10 km to a few tens of thousands of kilometers, MMS will probe the crucial microscopic physics involved in these fundamental processes; determine the 3-D geometry of the plasma, field, and current structures associated with them; and relate their microscale dimension to phenomena occurring on the mesoscale. By acquiring data simultaneously at multiple points in space, MMS will be able to differentiate between spatial variations and temporal evolution, thus removing the space-time ambiguity that has limited single-spacecraft studies of magnetospheric plasma processes.

The baseline MMS mission defined by the STDT is planned to have an operational duration of two years and will be conducted in four phases, which are defined by changes in the orbital parameters. In Phases 1 and 2, the S/C cluster will be in a 10-degree inclination orbit. During Phase 1, the scientific emphasis will be on processes occurring at the low latitude dayside magnetopause and on substorm related processes in the near Earth magnetotail. Phase 2 will focus on the investigation of the dawnside flank of the equatorial magnetopause and the magnetotail at distances up to 30 Earth radii (RE), with special interest in substorm onset and evolution. Phases 3 will use lunar swingbys to take the S/C out to 120 RE in the deep tail and then to rotate the plane of the orbit to become perpendicular to the plane of the ecliptic. During this phase, MMS will investigate plasmoid evolution and the nature of merging at the distant neutral line. Phase 4 will be conducted from the 90 degree inclination orbit achieved through the rotation of the orbital plane during Phase 3 and will focus on the investigation of the entire dayside magnetopause, which it will skim from

north to south, with additional interest in studies of the midtail. A more detailed description of the planned mission is in the referenced STDT report.

5.1.1 Nominal Payload Resources

The following payload description is considered to be for a strawman payload; proposals may reflect changes to achieve their proposed science goals. All four MMS S/C will be identically instrumented and each will carry a payload consisting of instrumentation to measure fields and particles. Technical details of example instruments are given in the referenced MMS STDT report. In addition to the suite of instruments for each S/C, it is required that one fully qualified flight spare of each instrument be provided. The ISST will be responsible to design, qualify, and deploy external booms and antennae required by the instrument suite. Characteristics of these external booms and antennae will be coordinated between the S/C vendor and instrument provider. The maximum possible values of spacecraft resources for the MMS payload are based on NASA's accommodation studies and given in Table 5.1 as guidelines.

Table 5.1. Nominal Payload Resources for each MMS S/C

	Mass [kg]	Operational Power [W]	Data Rate Normal [kbps]	Data Rate Burst [kbps]
Totals	44	34	18	104

5.1.2 Description of NASA-Provided S/C

The following S/C description is for a strawman S/C; proposals may reflect changes to the required S/C interfaces or characteristics in order to achieve their proposed science goals. However, any changes to the nominal payload resources or strawman S/C characteristics needed by a proposed payload must be indicated and justified in the proposal.

S/C Configuration

It is the intention of the Government to procure the MMS S/C through the NASA Rapid Spacecraft Development Office (RSDO). At the time of this AO, the strawman concept for the S/C design is shown in the MMS STDT report, Figure 8.1, page 29.

Although the underlying philosophy of the S/C design is to decouple the instrument payload and S/C functions as much as possible, the constraints indicated in Table 5.1 have influenced the strawman design. Due to the constraint on the height of the individual S/C necessary to allow their stacking in the launch vehicle's shroud, the instrument electronics and sensors (except for sensors mounted on booms) will be distributed on S/C 's structural members consistent with field of view requirements. The upper and lower surfaces of the S/C will be used as radiators and the side surfaces will be covered with solar array panels with appropriate cutouts for sensors. The S/C is expected to have a minimal role in instrument commands and telemetry. In general, communication services are expected to consist of a "bent pipe," i.e., a relay of commands to and

from the instrument interface with no data processing provided by the S/C. Notable exceptions to this approach are S/C safety, thruster firings, and science alerts.

Ranging System

In order to achieve its desired science objectives, an accurate measurement of the separations between the MMS S/C is needed. Since the current RSDO-cataloged S/C do not provide an interspacecraft ranging system, a separate system will be provided, if required by the selected science investigation, to measure the distance between the spacecraft with accuracy $\leq 1\%$ for spacecraft separations of 10 to 6400 km. In addition, the ranging system is expected to be capable of correlating time among the four S/C to less than 400 μsec . In no case, however, will the ranging system be used to autonomously control the observatories. Currently, the European Space Agency (ESA) is being considered as a provider of the interspacecraft ranging system, but the determination of who will provide the system will not be made until the requirements are known.

Attitude Determination and Control

Spin stabilization is assumed for attitude control, with the spin axis nominally oriented at an offset of 2 to 5 degrees from the normal of the ecliptic plane to avoid shadowing of sensors. Postprocessed attitude knowledge of the spin axis will be <0.1 degree, and postprocessed spin phase knowledge will be <0.1 degree. The spin rate will be controlled to ± 0.2 rpm and nutation will be passively damped to <1 degree. Orbit adjust and spin axis precession maneuvers may require periodic reorientation of the spin axis.

The S/C will be dynamically stable in all mission phases. Prior to deployment of the electric field booms the spin-to-tumble inertia ratio will be >1.04 . With any instrument-required booms deployed, the boom dynamics will dominate the spin dynamics of the S/C. Therefore, it is anticipated that the dynamic properties of the booms and the damping of wire runs will be coordinated between the S/C vendor and instrument providers.

Electrical Interface

The S/C will supply unregulated $+28 \pm 7$ volts DC power on a main power bus and a survival heater bus for the science payload. The S/C will control the main bus power relays and each circuit will be fused in the S/C. Power to the survival heater bus will be available continuously throughout the mission. Passive thermostats with fixed set points will be used to control the survival heaters.

Intrument harnessing (including mass) is the responsibility of the instrument provider in coordination with the S/C vendor. The S/C vendor will provide all other harnessing.

The instruments must be designed to meet the EMI requirements in the GSFC General Environment and Verification Specification (GEVS) referenced in Appendix C.

Table 5.2. S/C Resource Summary.

Bus Voltage	28 +/- 7 V
Survival Heater Voltage	28 +/- 7 V
Data Bus	MIL-STD 1553B (bi-directional)
Data Bus Protocol	CCSDS (or equivalent)
Timing Signal	1 Hz
Stored Command Capacity	200 kilobytes
On-board Data Storage	3.5 gigabytes
Spin Rate	< 20 rpm (+/- 0.2 rpm)
Spin Axis Knowledge (post processing)	<0.1°
Spin Phase Knowledge (post processing)	<0.1°
S/C Magnetic Field (DC)	1 nT
S/C Magnetic Field (AC)	0.1 nT (up to 20 HZ)
S/C Surface Potential	< 3 V

5.1.3 Instrument Accommodations

Command and Data Handling Interfaces

The S/C computer controls all S/C operations. With respect to the spacecraft-to-instrument interfaces, the S/C computer provides instrument commands, collects and stores telemetry, and distributes a timing signal. A MIL-STD 1553B data bus is the baseline method for the command and telemetry data system with the S/C acting as the bus controller. Data transfers are packetized using the Consultative Committee for Space Data Systems (CCSDS) or other mutually agreeable packetized data protocol.

The S/C will send command packets to the instruments without processing; therefore, it is the responsibility of the instrument provider to define the formats of the data portions of its command packets. In normal operations, the S/C will not generate commands autonomously but it will support storage of command packets for distribution to the instrument at a later time. The aggregate size of the memory available to all instruments for stored commands is approximately 200 kilobytes. Stored command packets may be individually time tagged with one second precision, or may be part of a macro sequence.

The S/C will generate a 1 Hz timing pulse that will be distributed to each instrument. The S/C shall distribute information that can be used to correlate the 1 Hz timing pulses among the S/C.

The S/C will collect data from the instruments via the MIL-STD 1553B bus and store the data in the onboard data recorder. It is the instrument provider's responsibility to generate each science packet according to the full CCSDS telemetry format or other mutually agreed to format, including the generation of header information. Any processing or data compression is the responsibility of the instrument provider.

Mechanical Interfaces

The MMS Instrument Mechanical Design shall comply with the requirements of being launched on the Delta 7925H launch vehicle as defined in the GSFC General Environment and Verification Specification (GEVS) for STS and ELV Payloads, Subsystems and Components, Revision A (See Appendix C).

Thermal Interfaces

Instrument components mounted to the S/C structure will be thermally conductive to the S/C structure. Coordination between the instrument provider and the S/C vendor is expected. In general, instrument components internal to the S/C will be maintained between 0 and 40^o C.

S/C Propulsion

The S/C will have a propulsion system, and thruster firings are anticipated. The placement of the thrusters and a contamination path analysis are not available at this time, but the S/C will provide a warning to all instruments via the 1553 bus prior to the firings. Each instrument must provide its own protective mechanisms if contamination protection is required during the firings.

S/C Magnetic Properties

The S/C will not generate a DC magnetic field of more than 1 nT at the instrument boom mounted magnetometer sensor head. The S/C will not generate an AC magnetic field of more than 0.1 nT in the frequency range 0.001 Hz to 20 Hz at the magnetometer sensor head.

The S/C and instruments will be designed to the EMI Requirements of the GSFC GEVS document referenced in Appendix C.

Electrostatic Discharge Control

The MMS instruments are expected to measure very low levels of plasma energy so the S/C will be designed to not disturb the surrounding plasma. It is anticipated that the S/C exterior surface shall be an equipotential surface with no point of its exterior surface more than a 3 V difference from any other point including its insulation blankets and solar arrays.

Contamination

The ISST PI shall define the contamination requirements for the MMS instruments, which shall then be coordinated with the MMS S/C vendor.

5.1.4 Mission Operations Support

MMS mission operations are designed to support the S/C integration and testing, launch preparation, early orbit checkout, and all orbital operations. The Mission Operations Center

(MOC) will have responsibility for the control, commanding, telemetry download distribution, and health and safety monitoring of the MMS S/C. Data will nominally be downlinked serially from each of the S/C. Instrument commands from the ISST PI's Science Operations Center (SOC) (see Section 5.1.5 below) will be received by the MOC, which will manage the S/C and instrument uplink loads for transmission to the S/C.

The mission is being designed to implement autonomous operations, such as unattended S/C contacts and the use of automated paging to achieve better management of S/C anomalies. The mission operations center will be capable of scheduling and supporting emergency commercial and Deep Space Network (DSN) contacts to mitigate S/C or space weather emergencies.

5.1.5 Science Operations Center (SOC)

The SOC is solely responsible for the health and safety of the MMS instruments. The SOC is to be provided by the ISST and is hence part of the content solicited in this AO. All instrument commands will originate in the SOC and be given to the MOC for transmission to the S/C. Proposers are reminded to include the cost of instrument health and safety oversight during the mission phase.

5.1.6 Project Schedule

The MMS Mission is expected to be launched in January 2009. Based on the current implementation plan, which is subject to revision during Phase A, the flight models of all instruments will be required by August 2007 for integration and integrated testing. Proposals must clearly identify sufficient reserves (both schedule and financial) to ensure on time delivery of the instruments.

The draft Project Schedule, as currently established, is shown below.

• AO ISST Phase A Selections Announced	June 2003 (goal)
• Instrument Suite Phase A Concept Studies Complete	December 2003
• Instrument Suite Downselect	May 2004
• Instrument Suite Systems Requirements Review	September 2004
• Initial Confirmation Review	November 2004
• RSDO S/C Selection	July 2004
• Instrument Suite Preliminary Design Review (PDR) Complete	March 2005
• RSDO S/C Mission Design Review	March 2005
• Mission PDR	July 2005
• Mission Confirmation Review	September 2005
• Instrument Suite Critical Design Review (CDR) Complete	November 2005
• Mission CDR	July 2006

- Begin Instrument Suite Delivery May 2007
- Complete Instrument Delivery August 2007
- Mission Environmental Testing Complete May 2008
- Launch Ready July 2008
- Launch (next launch opportunity after launch readiness) January 2009

5.2 Technical Approach and Management Requirements

5.2.1 *General Considerations*

Proposed investigations must encompass all technical aspects from the initial studies, through data collection and analysis, publication of results, and final delivery of the data to the appropriate NASA data archive, as well as planning and implementation of an appropriate E/PO program.

The NASA Policies and Guidelines document, NPG 7120.5A, *NASA Program and Project Management Processes and Requirements*, delineates activities, milestones, and products typically associated with each of these phases and should be used as a reference in defining a team's approach. This document is included in the MMS Library (see Appendix C). Investigation teams shall abide by all necessary Federal (including NASA), state, and local laws and regulations.

NASA intends to allow the Principal Investigator and his/her team to use their own management processes, procedures, and methods to the fullest extent practical, and the use of innovative processes is encouraged when cost, schedule, technical improvements, and reliability can be demonstrated. Investigation teams should define the management approach best suited for their particular teaming arrangement, including the E/PO program, which should be commensurate with the investigation's implementation approach, while retaining a simple and effective management structure necessary to assure the adequate control of development within the cost and schedule constraints.

Each proposal must present a Work Breakdown Structure (WBS) as described in Appendix B, Section E.

5.2.2 *Leadership of ISST*

The MMS ISST must be led by a single Principal Investigator (PI) who is responsible for managing his/her selected investigation and interfacing with the NASA Goddard Space Flight Center (GSFC) MMS Project Office through the Instrument Systems Manager assigned to the investigation and through the GSFC MMS Project Scientist. Since multiple instruments are expected to be proposed as a suite within the single investigation, the PI will be the single point of contact with management responsibilities for the combined effort. The PI is accountable to NASA for the scientific success of the investigation, with full responsibility not only for its scientific integrity, but its implementation as well, from development of the proposal through all phases of the investigation, including the E/PO program. One ISST CoI should be designated as lead

investigator for each instrument on the suite, with a total of up to four. These Col's will also serve on the MMS SWG.

The selected investigation must have a professional Project Manager (PM) who will oversee the technical implementation of the investigation. The role, qualifications, and experience of the PM should be adequate to ensure that the technical and managerial needs of the investigation will be met. If the PM cannot be named in the proposal, the proposal should include a discussion of when and how an appropriately experienced PM will be selected.

5.2.3 Risk Management and Quality Assurance

The proposer must define the risk management approach he/she intends to use to ensure successful achievement of its objectives within established resource, funding, and schedule constraints. Included in this discussion of risk management should be risk mitigation plans for any new technologies to achieve a Technical Readiness Level (TRL) of 5 or better by the end of Phase A and TRL 6 or better by the end of Phase B and the need for any long-lead items that need to be placed on a contract before the start of the Implementation phase, in order to ensure timely delivery (see the TRL Definition Chart available via Appendix C). In addition, any manufacturing, test, or other facilities needed to ensure successful completion of the proposed investigation should be identified. The proposer must describe the approach for managing risk that will mitigate loss of the mission or serious degradation due to errors by human operators or errors or malfunctions in the mission data systems during the flight phase.

Selected investigations shall have a safety and mission assurance program that meets the requirements in the *MMS Mission Assurance Requirements* (MAR) document, available in the MMS Library (see Appendix C). The MMS MAR will become part of the contractual requirements for the MMS missions. The MAR defines specific products and processes required during the design and development phases of the investigation. Proposers should note that the MMS MAR requires a Grade 2 parts program and generate instrument cost proposals accordingly. Investigation teams must provide for the impact of these requirements when developing proposed costs.

5.2.4 Required Project Reviews and Meetings

The technical and management reviews that the selected ISST PI is expected to support are given in Section 5.1.6 above. Additional information pertaining to these reviews can be located in the MMS Library (see Appendix C) in the MMS MAR document. Additional reviews may also be scheduled during the life of the project.

The Principal Investigator will be expected to support the MMS mission by participating in all scheduled NASA/GSFC/MMS programmatic and technical meetings as appropriate; therefore, proposals to this AO need to allow for necessary travel costs. Weekly project-level teleconferences will also be conducted by the GSFC Project Office to exchange technical data regarding the mission requirements, risk and schedule status, and spacecraft-to-instrument interfaces. Reviews of the planning and implementation of the E/PO program will be included as an integral element of major management reviews.

5.2.5 *Co-Investigator Roles and Requirements*

A Co-Investigator is defined to be an investigator who plays a necessary role in the proposed investigation and whose services are either funded by NASA or are contributed. If funded by NASA, costs must be accounted for in the NASA OSS Cost. If contributed, the costs must be accounted for in the Total Cost and an endorsement letter from the proposed Co-Investigator's institution must be provided with the proposal (see Appendix B, section H.2). The role of each Co-Investigator must be described in the proposal. Other nonfunded members of the proposal team may be included in the proposal as collaborators.

5.3 International Participation

Recognizing the potential scientific, technical, and financial benefits offered to all partners by international cooperation, participation by non-U.S. individuals and organizations in the MMS ISST is encouraged on the basis of no exchange of funds. Such participation may include, but is not limited to, the contribution of requisite scientific instruments, and the subsequent sharing of the data from the mission. Such contributions are not accounted against the mission cap. However, since such participation can add to management complexity and, therefore, risk, any proposed cooperative arrangements should offer significant benefits while maintaining clear technical and management interfaces. The proposal should discuss risks and benefits of proposed cooperative arrangements as well as management approaches to mitigating these risks.

Any proposal that includes international participation must provide sufficient cost, schedule, and management data in the proposal and in subsequent reviews to allow evaluation. Proposers are expected to adequately document cost and schedule data, management approaches and techniques, and to document the commitment of all team partners to those costs and schedules in order to lend credibility to the proposal; otherwise, a proposal may be judged unacceptable.

Proposers are advised that a contract or subcontract by a U.S. team with a non-U.S. participant using funds derived from NASA must meet all applicable NASA and Federal regulations. Proposers are further advised that these regulations will place additional requirements on investigation teams that must be explicitly included in discussions of the investigation's cost, schedule, and risk management. Refer to Appendix B, section H.7 for additional information.

S/C, launch vehicles and launch services, and space operations may also be contributed by international partners and should be included in all calculations and discussions of the total cost of the investigation, which is defined as the sum of the cost to NASA and the cost of the contributions (see section 7.3 and Appendix B, Section G).

The direct purchase of goods and/or services from non-U.S. sources is permitted except that NASA is precluded from purchasing non-U.S. launch vehicles, nor may NASA funds provided to a mission team be used to purchase a launch vehicle from a non-U.S. source. The provisions of launch services as a contribution to the MMS mission by a non-U.S. partner is acceptable only on a no-exchange-of-funds basis (i.e., at no cost to NASA). Only those non-U.S. launch vehicles with demonstrated reliabilities may be proposed for the MMS mission.

Participation by non-U.S. individuals and/or institutions in MMS investigations must be endorsed by their own institutions. If government support is also required, then a government endorsement is also needed. The letter(s) of endorsement must provide evidence that the non-U.S. institution and/or government officials are aware and supportive of the proposed investigation and, if selected, sufficient funds will be made available to undertake the activity as proposed. Such endorsements must be submitted per the schedule in Section 8.

5.4 MMS Data Policy

The MMS program seeks to provide data to a broad community of users that will use the MMS data set and eventually other missions to obtain a better understanding of Sun-Earth interactions, and in particular to address the MMS science objectives. The data and Mission Level Data (MLD) products will be treated as a public resource and will be made available for public access. The following principles will guide the development of the final data policy:

1. In accordance with the SEC open data and software policy, after the initial check out and calibration period (approximately two months after launch), the MMS database and requisite basic analysis software will be made available to the international community through a NASA-specified data center (see item 3 below). Thereafter, all data shall be made public with no more than a two month data processing period, assuming nominal mission performance. Once the calibrated MMS data are deposited in the specified data bank, it is the intention of NASA to provide support for extended data analysis through an openly competed MMS Guest Investigator (GI) Program.
2. To assure the continuity of the data in order to achieve the MMS science objectives, the ISST PI will maintain responsibility for scheduling of instrument operating sequences. Proposers must identify how they plan to satisfy this requirement from the standpoint of hardware, software, and personnel at an appropriately configured and staffed SOC, the location of which will be determined by the ISST PI and NASA during the prelaunch study phase.

Investigators are expected to provide training materials for the flight operations team and any specialized software required for basic analysis of data by the community. Generation of MLD products is the responsibility of the ISST PI.

5.5 Education and Public Outreach, New Technology, Small Disadvantaged Business Requirements, and Minority Institution Requirements

5.5.1 Education and Public Outreach (E/PO)

The Office of Space Science (OSS) expects education and public outreach to be a significant part of each OSS flight program and research discipline, and strongly encourages space science researchers to engage actively in education and public outreach as an important component of their

NASA-supported professional activities. In order to achieve this goal, OSS has developed a comprehensive approach for making education at K-14 education levels, as well as the enhancement of public understanding of space science, integral parts of all of its missions and research programs. The umbrella STP/LWS E/PO program currently being defined will plan and implement a number of national efforts. The key documents that establish the basic policies and guide all OSS education and outreach and the STP/LWS E/PO Program Overview activities are referenced in Appendix C and can be accessed through the MMS Library.

NASA seeks assurance that the proposer is personally committed to the E/PO effort and that the PI and/or appropriate research team members will be actively involved in carrying out a meaningful, effective, credible, and appropriate E/PO activity; that such an activity will be thoughtfully planned and carefully executed; and that the proposed investment of resources will make a significant contribution toward meeting OSS E/PO goals and objectives. OSS expects E/PO to be handled just as thoroughly and professionally as are the scientific and engineering aspects of OSS missions. Therefore, ISST proposals must include the Principal Investigator's commitment and approach for an education/outreach program, as described in Appendix B. A detailed E/PO implementation plan will be developed by each selected investigation as part of its Phase A concept study and will play an explicit role in the downselection process.

A general funding guideline of 1-2% of the total investigation budget should apply to the E/PO component of the proposed investigation. The funding guideline is intended to apply to the investigation as a whole (throughout all phases of the mission) and not necessarily to each individual year. Within the total funding envelope, year-to-year E/PO expenditures should be phased to optimize the output of the planned E/PO program over the life of the mission.

5.5.2 Advanced Technology

NASA seeks to infuse new technologies that enhance performance and reduce costs into its programs and to strengthen the mechanisms by which it transfers such technologies to the private sector, including the nonaerospace sector. The means by which NASA's Office of Space Science plans to implement new technology is described in the *Office of Space Science Integrated Technology Strategy*, which is available via the Internet at <http://spacescience.nasa.gov/admin/pubs/sse/index.htm>. Investigations dependent on new technology will not be penalized for risk provided that adequate plans are described to provide a reasonable back-up approach that will assure the success of the investigation.

5.5.3 Small Disadvantaged Businesses and Minority Institutions

The PI and team members shall agree to use their best efforts to assist NASA in achieving its goal for the participation of small disadvantaged businesses, women-owned small businesses, Historically Black Colleges and Universities, and other Minority Educational Institutions in NASA procurements. Investment in these organizations reflects NASA's commitment to increase the participation of minority concerns in the aerospace community, and is to be viewed as an investment in our future. Offerors, other than small business concerns, are also advised that contracts resulting from this AO will be required to contain a subcontracting concept that includes goals for subcontracting with small, small disadvantaged, and women-owned small business

concerns (see Appendix A, Section XIII). Proposers are advised that these requirements may be met at least in part if not totally through their proposed E/PO efforts.

6.0 PROPOSAL SUBMISSION INFORMATION

6.1 Resources for Additional Information

The MMS Library provides reference documents and background information on the MMS Mission, including science goals, technology and education/public outreach strategies, and information on management aspects of flight programs. The contents of the MMS Library are listed in Appendix C and the online version of the library is at <http://mms.larc.nasa.gov/mms>.

Inquiries regarding this AO may be directed to the MMS Program Scientist.

Dr. Mary Mellott
The Sun-Earth Connection Division
Code SS
Office of Space Science
NASA Headquarters
Washington, DC 20546-0001

Facsimile: 202-358-3987
E-mail: mmellott@hq.nasa.gov

Inquiries are preferred in writing and may be sent by fax or E-mail; the character string "MMS AO" (without quotes) should be used in the Subject line of all such transmissions. Any updates to information during this AO solicitation process will be made available at the WWW location where this AO is posted (<http://space.science.nasa.gov>, open "Research Solicitations" from the menu), including answers to questions submitted by proposers to the Program Scientist as discussed above (note: the author(s) of such questions will not be identified).

6.2 Preproposal Activities

6.2.1 Preproposal Conference

A Preproposal Conference will be held in the Washington, DC, metropolitan area in accordance with the schedule in Section 8. Further information, including logistics, is available at <http://mms.larc.nasa.gov/MMS>. Participants may not use NASA grant or contract funds to attend and must make their own travel arrangements. The purpose of this Conference will be to address questions about the proposal process for this AO, including a discussion of the evaluation criteria, procurement approach, International Trade Regulations, and Education and Public Outreach plans.

The Preproposal Conference will also answer those written questions that are received by NASA at least one week prior to the event; questions should be addressed to the MMS program Scientist at the address in Section 6.1. Additional questions submitted after this time, including those provided in writing at the Conference, may be addressed at the Conference only as time permits. Anonymity of the authors of all questions will be preserved. An MMS AO Preproposal Conference Transcript, including answers to all questions addressed or submitted at the Conference, will be posted as part of the MMS Library approximately two weeks after the Conference.

6.2.2 Notice of Intent to Propose

A Notice of Intent (NOI) to propose should be submitted by each prospective Principal Investigator on or before the deadline given in Section 8. An NOI is not required but is strongly encouraged by NASA in order to assist in the planning of the evaluation of proposals. The NOI requests information to the extent known at the time of its submission, about the objectives of the proposed investigation, including E/PO; the instrumentation to be proposed; and the names, addresses, telephone numbers, and E-mail addresses of all prospective team members and their sponsoring organizations. It must be emphasized that MMS is a cost-capped mission. Hence, science team size must be minimized as much as practical (see Appendix B, Section C). All material provided to NASA through an NOI is for information only and is not binding on the submitter.

An NOI to propose is submitted by logging into the NASA Headquarters proposal data system at <http://proposals.hq.nasa.gov>. Access to the Web site for the electronic submission of a NOI for the MMS AO will then be found under the listing “OSS – Sun Earth Connection” in the menu entitled Division Specific Opportunities. Proposers having difficulty with this activity may send an e-mail to the Help Desk at proposals@hq.nasa.gov.

6.3 Format, Content, Certifications, and Submission of Proposals

General NASA guidance for proposals is given in Appendix A of this AO, which is considered binding unless specifically amended in this AO. A uniform proposal format as given in Appendix B, is required from all proposers to aid in proposal evaluation. Failure to follow these instructions may result in reduced ratings during the evaluation process or, in extreme cases, could lead to rejection of the proposal without review.

Proposers must provide 50 copies of their proposal, plus the original signed proposal to the following address by 4:30 p.m. EST on the proposal deadline date given in Section 8:

Magnetospheric Multiscale Mission (MMS) AO
Office of Space Science
NASA Peer Review Services
Suite 200
500 E Street, SW
Washington, DC 20024

Point of contact for commercial delivery: Phone: 202 479-9030

All proposals received after the closing date will be treated in accordance with NASA's provisions for late proposals (Appendix A, Section VII).

NASA will notify the proposers in writing or E-mail that their proposals have been received. Proposers not receiving this confirmation within ten days after submittal of their proposals should contact the MMS program Scientist at the address given in Section 6.1.

7.0 PROPOSAL EVALUATION, SELECTION, AND IMPLEMENTATION

7.1 Evaluation Criteria, Factors, and Procedures

All proposals submitted in response to this AO will be subjected to a preliminary screening to determine compliance with the constraints, requirements, and guidelines of this AO. A checklist of those items required in the proposal is provided in the MMS Library (see Appendix C). Proposals not in compliance may be returned to the proposer without further review. Proposals in compliance with this AO after this preliminary screening, will be evaluated with respect the following criteria that have approximately equal weight:

- Science Merit of the proposed investigation, including its focus on the objectives discussed in Section 2.0 and the quality of science team;
- Technical Merit of the proposed instrument suite focused on the instruments and suite design, demands on S/C resources, and the ability to provide the data needed to accomplish the proposed investigation
- Feasibility focused on management of overall effort, qualifications of proposal team personnel and institution(s) to carry through to completion (in particular, the ability to produce at least four flight instrument suites), and cost realism and reasonableness.

These criteria will be evaluated by qualified peers of the proposing teams that will compile their evaluations using both narrative text and summary adjectival grades. These peer evaluations will then be provided to an *ad hoc* Categorization Subcommittee of the Space Science Steering Committee (see further below), composed wholly of Civil Servants, to categorize the proposals in accordance with procedures required by NASA Federal Acquisition Regulation (FAR) Supplement (NFS) Part 1872.403-1. These Categories are defined as follows:

Category I. Well conceived and scientifically and technically sound investigation pertinent to the goals of the program and the AO's objectives and offered by a competent investigator from an institution capable of supplying the necessary support to ensure that any essential flight hardware or other support can be delivered on time and that data can be properly reduced, analyzed, interpreted, and published in a reasonable time. Investigations in Category I are recommended for acceptance and normally will be displaced only by other Category I investigations.

Category II. Well conceived and scientifically or technically sound investigations which are recommended for acceptance, but at a lower priority than Category I.

Category III. Scientifically or technically sound investigations, which require further development.

Category IV. Proposed investigations which are recommended for rejection for the particular opportunity under consideration, whatever the reason.

7.2 Selection Procedures

Following the categorizations, the MMS Program Scientist will develop a recommendation for selection from among the Category I proposals, or if there are none, then from among any Category II proposals. This recommendation and the results of the peer evaluations will then be forwarded to the Space Science Steering Committee (SSSC), which is composed wholly of NASA Civil Servants and appointed by the Associate Administrator for Space Science. The SSSC will conduct an independent assessment of the evaluation and categorization processes regarding both their compliance to established policies and practices, as well as their completeness, self-consistency, and adequacy of all materials related thereto. The SSSC will also assess the recommendation for selection in light of the requirements and conditions set forth in this AO, and will submit its findings along with the entirety of all evaluation and categorization results to the Associate Administrator (AA) for Space Science. The AA for Space Science will make the final selection(s) in consultation with the OSS Deputy AA, the Executive Director for Science, and the SEC Division Director. The total proposed cost to OSS will be considered at this time in order to discriminate between proposals of otherwise equal scientific and technical merits.

It should also be noted that, in accordance with Section II of Appendix A, NASA reserves the right to select only a portion of a proposer's investigation and/or to invite his/her participation with other investigators in a joint investigation. In that case, all affected proposers will be given the opportunity to accept or decline such partial acceptance and/or participation with other investigators. Declining such an offer may result in NASA withdrawing its offer of selection under any circumstances.

The selected proposer(s) will be notified immediately by phone and then by letter and provided with instructions for initiating the Phase A study. A Project Initiation Conference will be held as soon as possible after selection to clarify requirements and responsibilities of all parties having roles. The proposer(s) not selected will be notified by letter and will be offered a debriefing. Such debriefings may be in person at NASA Headquarters or, if the investigation team prefers, by telephone. NASA funds may not be used to defray travel costs by the proposer for a debriefing. In either case, along with the proposing Principal Investigator, a lead representative from the key participating institution(s) of a proposal may also attend such debriefings.

7.3 Implementation Procedures

7.3.1 *Award Administration and Funding*

Each contract resulting from this selection for Phase A studies will contain a priced option for a bridge phase, as well as an option for follow-on mission phases (B/C/D/E). These options will be exercised by NASA for investigations selected to proceed into phase B/C/D. The bridge phase is intended to cover the selected investigation team efforts after Phase A and before Phase B (approximately 3 months) to provide program continuity while the Phase B/C/D and E negotiations are completed. The Phase A bridge effort will continue until the MMS Project has received concurrence from NASA Headquarters to enter into Phase B with a single ISST MMS investigation.

7.3.2 *Phase A Concept Study*

The Phase A concept studies are intended to provide NASA with more definitive information regarding the cost, risk, and feasibility of the investigations, as well as a concept for the conduct of an appropriate education and outreach program, new technology and SDB concept before final selection for implementation. During the Phase A study, a Project Systems Engineering team will act as a resource to the selected investigations for S/C interface and trade study purposes. The product of the concept studies will be reports to be delivered by each selected investigation team six months after the Project Initiation Conference. The content and format of the study reports are specified in the Guidelines and Criteria for the Phase A Concept Study document in Appendix C. The NASA review of the completed concept study report will include all mission facets including E/PO. NASA may request presentations and/or site visits to review the final concept study results with the investigators.

7.3.3 *Phase B*

The choice of one investigation team selected through this AO to continue into Phase B will be made by the Associate Administrator for Space Science based upon NASA review of the Phase A concept study results and programmatic considerations. The criteria for evaluating the concept study are as follows:

- Scientific merit;
- Technical merit and feasibility of the proposed investigation;
- Feasibility of the proposed approach for investigation implementation, including cost risk to the mission and impact to spacecraft resources; and
- Quality of plans for education and public outreach, advanced technology infusion and transfer, and subcontracting plans for small disadvantaged business activities and minority institutions.

The criteria for continuation into Phase B are described in the Guidelines and Criteria for the Phase A Concept Study document in Appendix C. Any changes to science and the science implementation scheme contained in the Phase A Concept Study Report will be carefully

evaluated. Assuming no changes to the first two criteria, the emphasis for continuation into Phase B will be on the latter two.

As a result of evaluation of the concept studies, NASA expects to authorize one suite investigation to proceed by exercising their bridge phase options. In no case, however, is NASA required to exercise any option. NASA will not exercise the contract option nor continue funding those investigations not selected to proceed.

Should a selected proposal involve non-U.S. participation, NASA's Office of External Relations will arrange with the foreign sponsor for the proposed participation on a no-exchange-of-funds basis, in which NASA and the foreign sponsor will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail a letter of notification by NASA with a subsequent exchange of letters between NASA and the foreign sponsor, or a formal agency-to-agency Memorandum of Understanding (MOU).

8.0 SCHEDULE

The schedule of events associated with this Announcement of Opportunity is as follows:

Release AO	January 3, 2003
Preproposal Conference	January 17, 2003
Notice of Intent due	January 31, 2003
Proposal submittal due by 4:30 PM EDT	March 19, 2003
Letter(s) of Endorsement for Non-U.S. participants due	April 16, 2003
Selection of Investigations for Phase A Study (goal)	July, 2003
Award of Phase A Study Contracts (goal)	Selection + 2 weeks, 2003

9.0 CONCLUSION

The Magnetosphere Multiscale mission represents a significant step in accomplishing the goals of NASA's Solar Terrestrial Probes Program. NASA invites both the U.S. and international space science communities to participate in proposals for investigations to be carried out as a result of this Announcement.

Richard R. Fisher
Director
The Sun-Earth Connection Division

Edward J. Weiler
Associate Administrator for
Space Science

APPENDIX A

GENERAL INSTRUCTIONS AND PROVISIONS

I. INSTRUMENTATION AND/OR GROUND EQUIPMENT

By submitting a proposal, the investigator and institution agree that NASA has the option to accept all or part of the offeror's plan to provide the instrumentation or ground support equipment required for the investigation or NASA may furnish or obtain such instrumentation or equipment from any other source as determined by the selecting official. In addition, NASA reserves the right to require use, by the selected investigator, of Government instrumentation or property that becomes available, with or without modification, that will meet the investigative objectives.

NOTICE TO ALL OFFERORS: In the event that a Principal Investigator employed by NASA is selected under this AO, NASA will award prime contracts to non-Government participants, including Co-Investigators, hardware fabricators, and service providers who are named members of the proposing team, as long as the selecting official specifically designates the participant(s) in the selection decision. Refer to Section H of Appendix B of this AO for proposal information that the selecting official will review in determining whether to incorporate a non-Government participant in the selection decision. Each NASA contract with hardware fabricators or service providers selected in this manner will be supported by an appropriate justification for other than full and open competition, as necessary.

II. TENTATIVE SELECTIONS, PHASED DEVELOPMENT, PARTIAL SELECTIONS, AND PARTICIPATION WITH OTHERS

By submitting a proposal, the investigator and the organization agree that NASA has the option to make a tentative selection pending a successful feasibility or definition effort. NASA has the option to contract in phases for a proposed experiment and to discontinue the investigative effort at the completion of any phase. The investigator should also understand that NASA may desire to select only a portion of the proposed investigation and/or that NASA may desire the individual's participation with other investigators in a joint investigation, in which case the investigator will be given the opportunity to accept or decline such partial acceptance or participation with other investigators prior to a selection. Where participation with other investigators as a team is agreed to, one of the team members will normally be designated as its team leader or contact point.

III. SELECTION WITHOUT DISCUSSION

The Government reserves the right to reject any or all proposals received in response to this AO when such action shall be considered in the best interest of the Government. Notice is also given of the possibility that any selection may be made without discussion (other than discussions conducted for the purpose of minor clarification). It is, therefore,

emphasized that all proposals must be submitted initially on the most favorable terms that the offeror can submit.

IV. NONDOMESTIC PROPOSALS

The guidelines for proposals originating outside of the United States are the same as those for proposals originating within the United States, except that the additional conditions described in Section 5.3 of the AO shall also apply.

V. TREATMENT OF PROPOSAL DATA

It is NASA policy to use information contained in proposals and quotations for evaluation purposes only. While this policy does not require that the proposal or quotation bear a restrictive notice, offerors or quoters should place the following notice on the title page of the proposal or quotation and specify the information subject to the notice by inserting appropriate identification, such as page numbers, in the notice. Information (data) contained in proposals and quotations will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice. To prevent inadvertent disclosure, proposal data shall not be included in submissions (e.g., final reports) that are routinely released to the public.

Restriction On Use and Disclosure of Proposal and Quotation Information (Data):

The information (data) contained in (insert page numbers or other identification) of this proposal or quotation constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed for other than evaluation purposes; provided, however, that in the event a contract is awarded on the basis of this proposal or quotation, the Government shall have the right to use and disclose this information (data) to the extent provided in the contract. This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

VI. STATUS OF COST PROPOSALS

Submission of cost or pricing data, as defined in FAR 15.401, is required if the combined Phase A and Bridge Phase costs exceed \$750,000. Cost or pricing data will also be required for proposals for subsequent investigation phases. The investigator's institution agrees that the cost proposal submitted in response to the Announcement is for proposal evaluation and selection purposes, and that, following selection and during negotiations leading to a definitive contract, the institution may be required to resubmit or execute all certifications and representations required by law and regulation.

VII. LATE PROPOSALS

The Government reserves the right to consider proposals or modifications thereof received after the date indicated, should such action be in the interest of the Government.

VIII. SOURCE OF SPACE INVESTIGATIONS

Investigators are advised that candidate investigations for space missions can come from many sources. These sources include those selected through the AO, those generated by NASA in-house research and development, and those derived from contracts and other agreements between NASA and external entities.

IX. DISCLOSURE OF PROPOSALS OUTSIDE GOVERNMENT

NASA may find it necessary to obtain proposal evaluation assistance outside the Government. Where NASA determines it is necessary to disclose a proposal outside the Government for evaluation purposes, arrangements will be made with the evaluator for appropriate handling of the proposal information. Therefore, by submitting a proposal the investigator and institution agree that NASA may have the proposal evaluated outside the Government. If the investigator or institution desires to preclude NASA from using an outside evaluation, the investigator or institution must so indicate on the cover. However, notice is given that if NASA is precluded from using outside evaluation, it may be unable to consider the proposal.

X. EQUAL OPPORTUNITY

For any NASA contract resulting from this solicitation, the clause at FAR 52.222-26, "Equal Opportunity," shall apply.

XI. PATENT RIGHTS

A. For any contract resulting from this solicitation awarded to other than a small business firm or nonprofit organization, the clause at 1852.227-70, New Technology, shall apply. Such contractors may, in advance of a contract, request waiver of rights as set forth in the provision at 1852.227-71, Requests for Waiver of Rights to Inventions.

B. For any contract resulting from this solicitation awarded to a small business firm or nonprofit organization, the clause at FAR 52.227-11, Patent Rights—Retention by the Contractor (Short Form) (as modified by 1852.227-11), shall apply.

XII. RIGHTS IN DATA

Any contract resulting from this solicitation will contain the Rights in Data – General Clause: FAR 52.227-14.

XIII. SMALL AND SMALL DISADVANTAGED BUSINESS SUBCONTRACTING

A. Offerors are advised that, in keeping with Congressionally mandated goals, NASA seeks to place a fair portion of its contract dollars, where feasible, with small disadvantaged business concerns, women-owned small business concerns, Historically Black Colleges and Universities, and minority educational institutions, as these entities are defined in 52.219-8 and in 52.226-2 of the FAR. For this Announcement of Opportunity, the offeror's subcontracting plan will be evaluated on the participation goals and quality and level of work performed by small disadvantaged business concerns, women-owned small business concerns, Historically Black Colleges and Universities, and other minority educational institutions. Offerors will be evaluated on the participation in the performance of the mission of small disadvantaged business concerns in the authorized Standard Industrial Classification (SIC) Groups as determined by the Department of Commerce (see FAR 19.201 (b)), as well as the participation of women-owned small business concerns, HBCU's and OMI's.

B. Offerors are advised that for NASA contracts resulting from this solicitation that offer subcontracting possibilities, exceed \$500,000, and are with organizations other than small business concerns, the clause FAR 52.219-9 shall apply. Offerors whose investigations are selected under this AO will be required to negotiate subcontracting plans which include subcontracting goals for small, small disadvantaged, women-owned, veteran-owned, and HUB Zone small business concerns. Note that these specific subcontracting goals differ from the goals described in paragraph A above, and need not be submitted with the proposal. Failure to submit and negotiate a subcontracting plan after selection shall make the offeror ineligible for award of a contract.

APPENDIX B

SPECIFIC GUIDELINES FOR PROPOSAL PREPARATION IN RESPONSE TO THIS AO

The following guidelines apply to the preparation of proposals in response to this MMS Announcement of Opportunity (AO). The material presented is a guide for the prospective proposer and is not intended to be all encompassing. The proposer must, however, provide information relative to those items applicable or as otherwise required by the Announcement of Opportunity. In the event of an apparent conflict between the guidelines in this Appendix and those contained within the body of the AO, those within the body of the AO shall take precedence.

GENERAL GUIDELINES

All documents must be typewritten in English, use the metric system of units, and be clearly legible. Submission of proposal material by facsimile (fax), electronic media, videotape, floppy disk, etc., is not acceptable, nor may a proposal reference a WWW site for data or information needed to understand or complete the proposal. In evaluating proposals, NASA will only consider printed material that is submitted.

The proposal must consist of only one volume, with readily identified sections corresponding to sections A through G given below. Proposals shall adhere to the page limits in Table B-1, including no more than two fold-out pages (28 x 43 cm; i.e., 11 x 17 inches) that count as one page each. Every side upon which printing appears will be counted against the page limits. All pages other than fold-out pages shall be 8.5 x 11 inches or A4 European standard.

Single- or double-column format is acceptable. In complying with the page limit, the type font shall not be smaller than 12-point (i.e., no more than ~15 characters per inch), and 1 inch (2.5 cm) margins shall be used all around (note: A4 paper should use 2.5 cm margins at the top and both sides, and 4 cm at the bottom). Smaller font is allowed for figures, captions, and in cost tables provided that legibility is preserved.

In order to allow for recycling of proposals after the review process, all copies of the proposal must be submitted on plain white paper only (i.e., no cardboard stock or plastic covers, colored paper, etc.). Proposers are not permitted to use three-ring binders. Photographs and color figures are permitted if printed only on recyclable white paper. The original signed copy (including cover and endorsements) must be bound in a manner that makes it easy to disassemble for reproduction. Except for the original, two-sided copies are preferred.

Table B-1. Proposal Page Guideline

<u>Section</u>	<u>Page Limit</u>
Graphics Cover Page (optional)	1
Cover Page and Proposal Summary	Printout of electronic Web submission (See Section A below).
Table of Contents	As needed.
Science Investigation Description	37
Mission Operations Support, Science Operations and Data Analysis Plan Concept	6
Education/Public Outreach	2
Technology, and Small, Disadvantaged Business/Minority Institution Plan Concept	2
Management, Schedule, Cost Estimating Methodology, Risk Management Plan Concept, and Cost Plan Concept	25 plus required cost table(s).
<u>Appendices</u> (No others permitted):	No page limit but small size encouraged.
<ul style="list-style-type: none">• Signed Resumes (2 pages maximum each person) from PI, PM, and each Co-I• Letter(s) of Endorsement from Participating Institution(s)• Statement(s) of Work• References• Description of Team Member Selection (applicable for NASA PI's only)• Technical Content of International Agreements (only as applicable)• Discussion on Compliance with U. S. Export Laws and Regulations (only as applicable)	

The content of each proposal shall be as follows:

A. COVER PAGE AND PROPOSAL SUMMARY

A Cover Page and Proposal Summary must preface the proposal and be signed by the Principal Investigator and an official by title of the investigator's organization who is authorized to commit the organization. This authorizing signature now also certifies that the proposing institution has read and is in compliance with the three required certifications printed in full in Appendix D; therefore, these certifications do not need to be submitted separately. The full name of the Principal Investigator and the authorizing

official, their addresses with zip code, telephone and fax numbers, and electronic mail addresses, are required on the Cover Page. Additional required information includes the names, institutions, and E-mail addresses of all participants, type of instrument(s) proposed, total investigation cost, and a 220-word Proposal Summary (including E/PO).

The Cover Page/Proposal Summary is generated by filling in the form provided for this program at the WWW site located at <http://proposals.hq.nasa.gov/> and accessing the site for this AO through the listing “OSS - Sun Earth Connection” in the menu entitled Division Specific Opportunities. Once the requisite information is supplied, it is submitted electronically to that WWW site and a hard copy is printed in time to acquire signatures for inclusion with the hard copies of the proposal for delivery according to the schedule provided in Section 8 in this AO. Proposers are advised that they must not reformat or correct this Cover Page after it is submitted and printed, as important NASA-required documentation may be lost; amendments to this item are possible up to the time of its final submission by following the directions at this Web site. Proposers without access to the Web or who experience difficulty in using this site may send an E-mail to proposals@hq.nasa.gov asking for assistance. Please note that submission of the electronic Cover does not satisfy the deadline for proposal submission.

It is NASA's intent to enter the Proposal Summaries of all selected investigations for its various programs into a publicly accessible database. Therefore, the Proposal Summary should not contain proprietary or confidential information that the submitter wishes to protect from public disclosure (see also Section V, Appendix A.)

An optional graphic cover page of a design and content of the proposer's own choosing may be placed ahead of the copy of the electronically submitted Cover Page. It will not count against the page limit as long as it contains no technical information not found in the body of the proposal. It should, however, prominently carry the names of the proposed investigation, the Principal Investigator, and the proposing institution.

B. TABLE OF CONTENTS

The proposal must contain a Table of Contents that parallels Sections C through D below.

C. SCIENCE INVESTIGATION

The science section must describe the scientific objectives of the proposed investigation, including the perceived value of the investigation to the MMS science objectives. A thorough discussion of the scientific products must be provided, including how they will be attained and how they will be used to fulfill the scientific objectives.

1. Scientific Goals and Objectives.

This section must consist of a discussion of the goals and objectives of the investigation including their value to the specific MMS objectives described in this AO.

The measurements to be taken in the course of the mission, the data to be returned, and the approach that will be taken in analyzing the data to achieve the scientific objectives of the investigation must be discussed. This description must identify the investigation to be performed, the quality of the data to be returned (resolution, coverage, pointing accuracy, measurement precision, calibration, etc.), and the quantity of data to be returned (bits, etc.). The relationship between the data products generated and the scientific objectives must be explicitly described. The improvement over current knowledge that the results of the investigation are expected to provide must be clearly stated.

2. Science Implementation.

a. Instrumentation. This section must describe and justify the instrument suite and the criteria used for its selection. This section must identify the individual components of the instrument suite (including any mechanisms) and instrument systems, including their characteristics and requirements. In addition, the proposal must describe how the data that are to be obtained with the proposed hardware are related to the MMS science objectives. Specific approaches being proposed to maximize the effective use of these data must be identified together with the proposer's plans for data processing and management.

In particular, the proposal must describe all parameters of the instrument suite that are pertinent to the accommodation of the instrument suite within the S/C resources and configuration advertised in this AO (and as may be updated at the WWW location where this AO is posted – see Section 5.1) plus any special requirements necessary for successful implementation. In particular, all enabling technologies must be identified and the TRL level defined. All enabling technology is required to be at a TRL level 5 or higher before a project may enter Phase B and at TRL level 6 or higher by the end of Phase B. A plan to meet the required TRL levels for each phase must be discussed. This information must be given in sufficient detail at the instrument suite component level to permit an evaluation of both the concept and the practical feasibility of the hardware. These resources include, but are not limited to: volumetric envelope, mass, power, and thermal requirements (including preferred thermal limits); telemetry and command requirements; environmental sensitivities (e.g., to electrical cleanliness, magnetic fields, and contamination); any special S/C or launch vehicle integration requirements or constraints; pointing requirements; and onboard data processing. Mass, power, and data processing budgets should be provided. The power discussion must outline average and peak power use and a time profile of power needs.

The instrument suite component level reserves and margin for resources such as mass, telemetry, and power must be identified. Discuss the allocation of reserves and margin to the instrument and/or suite. By way of definition, contingency (or reserve) when added to a resource, results in the maximum expected value for that resource. Percent contingency is the value of the contingency divided by the value of the resource less the

contingency. Margin is the difference between the maximum possible value of a resource and the maximum expected value for a resource. Percent margin for a resource is the available margin divided by its maximum expected value.

Example: A suite has a maximum expected value of 40 kg which includes 5 kg of reserve. The percent reserve is 14%. The maximum possible value of the resource is 44 kg so the percent margin is 10%.

The proposal must outline hardware items that are proposed to be developed, as well as any existing instrumentation or design/flight heritage. The heritage of various components of the instrument suite, supporting systems, and software must be described. Note that, for any level of heritage claimed, cost information about the referenced sources of heritage will also be required in the section on cost-estimating methodology.

A preliminary description of the instrument suite design with a block diagram showing the components, instrument systems, and their interfaces must be included. In the case of a new or not-yet-space-qualified design, the instrument suite component or system must, to the extent possible, be compared based on performance, complexity, and cost to existing instruments. Since the locations of the interfaces are not finalized, proposers must identify possible locations for the electrical, mechanical, and data interfaces based on information provided in this AO (and as may be updated at the WWW location where this AO is posted; see Section 5.1). In addition, the preferred location of the instrument suite component itself on the S/C must be described. Where more than one choice is available, proposers must identify and justify their preference. Proposals must include a discussion of the requirements of the instrument suite component data rate (peak and average), field of view, resolution, sensitivity, pointing accuracy, etc.

The proposal shall provide a fabrication, test, and calibration concept by describing a fabrication plan, a test plan, and a calibration plan at the instrument suite and component level. The proposal shall address any impacts in order to produce multiple copies of flight hardware, including but not limited to, the areas of facilities, work force, schedule, manufacturability, validation, and verification. Instrument suite component testing and calibration during flight must also be described. The proposal shall include a flow diagram indicating order of assembly and tests. The description of the test concept shall include a verification matrix that describes the tests that are to be performed on components, development units, and subassemblies.

b. Mission. The observing strategy, within the framework of the expected S/C performance, required for obtaining the necessary data with the proposed instrumentation, must be described. Operational constraints, viewing, and pointing requirements must be identified. The concept and the expected requirements for supporting mission operations must be given. Requirements for pre- or post-launch ground operations support must be identified. The planned support for mission operations is described in Section 5.1.4 of the AO.

c. Science Team. This section must identify the investigation science team. It is required that every Co-I be individually named in the proposal and their role and

responsibilities be explicitly given. NASA strongly encourages proposers to identify only the most critically important personnel to aid in the execution of their proposals (Note: the inclusion of Co-I's who are judged by peer review to have either insignificant or unjustified roles in a proposed program of research will be considered a weakness for purposes of the evaluation of the proposal) Additionally, the roles and responsibilities of any other science team member funded for the investigation (defined as meaning anytime in Phases A-E) must also be explicitly defined and the capabilities and experience of all Co-I's and funded science team members must be described.

The names of all Co-I's and funded science team members must appear on the Cover Page and Proposal Summary. The PI must submit a signed resume or *Curriculum Vitae* (not to exceed the specified page limit) that includes his/her professional experiences, positions, and a bibliography of publications relevant to the proposal. Signed resumes or *Curriculum Vitae* of Co-I's and funded science team members must also be included in the Appendices (see Section G below) to the proposal. Note that by signing their resumes, the Co-I's acknowledge their participation as described in the proposal.

In addition, if that person or his/her institution will be providing or contributing hardware, software, or other tangible services, a letter from that institution must also be included that certifies their intended contribution.

D. DATA COLLECTION, ANALYSIS AND ARCHIVING

The MMS data reduction and analysis concept, following delivery of the data to the ground, must be discussed, including the method and format of the data reduction, data validation, and preliminary analysis. The process by which data will be made available to the public and prepared for archiving must be discussed, including a list of the proposed Mission Level Data (MLD) products, schedule, and the individual team members responsible for the data products. For the data archiving, the description must include a detailed schedule for the submission of raw and reduced data to the appropriate data archive in the proper formats, media, etc. Delivery of the data to the data archive must take place in the shortest time possible as specified by the NASA policy on open data access and Section 5.5 of the AO. The selection of who is responsible for archiving the MMS data is not part of this AO, nor is the funding for this effort included in the funds available through this AO. The selection of the party responsible for archiving the MMS data will be made by NASA during the prelaunch study phase. This does not preclude the ISST from being selected for this task.

E. EDUCATION, OUTREACH, TECHNOLOGY, AND SMALL DISADVANTAGED BUSINESS/MINORITY INSTITUTION CONCEPT

The Education/Public Outreach, technology, and small disadvantaged business/minority institution sections shall provide a summary of the benefits offered by the investigation beyond the scientific benefits. These sections must be included in the hard copy submission of the proposal, within the page limits outlined in Table B-1.

1. Education and Public Outreach Concept. The proposer must provide a statement that she/he understands NASA OSS requirements for Education and Public Outreach (E/PO) and is committed to carrying out an E/PO program that meets the goals described in Section 5.5.1. The proposer must also provide a brief overview of the planned E/PO activities and their relationship to the MMS mission. This overview should include a brief discussion of any unique characteristics of MMS that might provide unusual opportunities for E/PO. Detailed plans for implementing the E/PO activities, including identification of and formal commitment from E/PO partner institutions, will be part of the Phase A concept studies and will be evaluated as part of the authorization to continue into Phase B process.
2. Technology Concept. The proposal must address the use of new technology in the implementation of the investigation and the transfer of technology beyond NASA and the space science community (see Section 5.5.2 of this AO). Guidance on the use of new technology in investigations can be found in the Space Science Enterprise Integrated Technology Strategy, which can be accessed through the MMS online library (see Appendix C).
3. Small, Disadvantaged Business/Minority Institution Concept. Concepts are required for the proposed investigation's commitment to meet the small disadvantaged business participation goal. See AO Section 5.5.3 and Appendix A, Section XIII.

F. MANAGEMENT AND SCHEDULE

This section must summarize the investigator's proposed management approach, putting it in the context of the work to be accomplished. A Work Breakdown Structure (WBS) must be presented that covers the entire effort of the investigation, including E/PO. The management organization (including an organization chart) and decision-making process must be described and the teaming arrangement (as known) must be discussed. The responsibilities of team members, including contributors, and institutional commitments must be discussed. Unique capabilities that each team member organization brings to the team, as well as previous experience with similar systems and equipment, must be addressed. The specific roles and responsibilities of the key personnel, Principal Investigator, each Co-Investigator, and Project Manager, must be discussed. The relationship between the PI, his/her team, the instrument provider(s) (if not the PI), and NASA must be outlined. A Risk Management Plan Concept, including possible descope options with cost-savings indicated must be described.

A Project Schedule to meet the proposed launch date and covering all phases of the investigation must be provided, including the planning and implementation of the E/PO program. The schedule must include proposed review dates, instrument development and delivery, instrument to S/C integration and test, any special launch vehicle integration issues, and mission operations and data analysis. Schedule reserve must be clearly identified.

G. COST ESTIMATING METHODOLOGY AND COSTS

The Cost Plan must provide an estimate of the total lifecycle cost to NASA of the investigation, along with sufficient technical information to allow the reliability of the figures to be judged. The assumptions on which the estimate is based must be stated, particularly with regard to any requested Government furnished equipment and services. For purposes of this cost estimate, the proposer should assume delivery of any hardware in accordance with the Project Schedule shown in the AO, Section 5.1.6. Proposal cost estimates must include clearly identified and sufficient reserves of both schedule and financial resources to ensure on-time delivery.

The Cost Plan must have two parts: detailed total cost for Phase A and the Bridge phase, and an estimated cost plan for Phases B, C, D, and E. Contracts for a fixed price Phase A concept study and a Bridge Phase A effort with an option to continue into Phases B/C/D/E will be issued. During the bridge phase, the contract modification for Phase B through E will be negotiated. Proposers must estimate the Total NASA Cost (see Table B-2 below in this Appendix) in the proposal and, if selected through this AO, in much more detail in the Phase A implementation plans. Total NASA Cost for an investigation is the funding that NASA OSS would be expected to provide to the investigation team over the course of the investigation, beginning with selection and ending with the conclusion of Phase E. Examples of costs to be included are education and outreach activities; new technology; subcontracting costs (including fees); all science team personnel required to conduct the investigation, analyze and publish results, and deliver data in archival format; science operations center and ground data system; labor (contractor); noncontributed NASA Civil Servant costs; reserves; and contract fees. Contributions by foreign partners are not considered to be part of the Total NASA Cost. However, cost estimates for these contributions must be included (see Table B-2) to allow a full assessment of the Total Investigation Cost (Total NASA Cost plus foreign contributions).

Because the interfaces between the instrument suite and the S/C have not been finalized, proposers are asked to break down the estimates to a level that allows the total costs associated with major subsystems of the hardware to be identified. Since cost details for Phase B/C/D/E are not anticipated until the conclusion of Phase A, cost estimates in the proposal may be generated with models or cost estimating relationships from analogous investigations.

An investigation may be required to descope to meet cost or other resource constraints; therefore, the proposer shall identify a prioritized Risk Management Plan Concept for the removal of requirements, such as science objectives, reduction of testing, etc. The E/PO program element may not be considered a descope option. The decision points for achieving effective reductions in cost and schedule must be identified. The hardware and project costs associated with the investigation at each level of descoping must be estimated and any resulting schedule savings must be outlined.

This section shall include a first-order estimated cost of the investigation that encompasses all proposed activities, including Phases A/B/C/D/E, development of the ground system if there are any special requirements needed to support the proposed

instrument(s), fee, and contributions. S/C operations costs will be covered by the project, thus proposers need only include costs for science operations, data analysis, and EPO activities in their Phase E estimates. Costs must be consistent with the available resources defined in Section 1.4.1 of the AO. Since the available funding must support the entire science payload, proposers must justify their costs in terms of the overall mission objectives. The amount to be costed in each fiscal year must be identified by providing the data in Table B-2, which will not be counted against the page limit, using the elements of the proposer's WBS and any other items unique to the proposal. Proposers may define their own WBS; however, a sample WBS is provided in Table B-4. Note that the cost of Data Analysis must be shown separately from Science Operations costs. The top portion of Table B-2 requests cost data relative to the NASA Cost. The lower portion addresses both domestic and non-U.S. contributions.

Additionally, a separate Summary of Elements of Cost by Fiscal Year shall be provided for Phase A and the Bridge Phase. The summaries shall provide data by U.S. Government Fiscal Year (October 1 – September 30) in real year K dollars. A template and instructions for this summary are provided in Table B-3 and the Cost Table Instructions. Cost estimates for contributions should not be included in these summaries. Table B-5 gives the NASA inflation index. These rates should be used to calculate real-year dollars unless an industry forward pricing rate is used and documented.

A separate Table B-2 is required for each instrument and major component (e.g., common central data processing unit) in the suite, and one Table B-2 and one Table B-3 is required that shows the total cost for the suite. For example, if four instruments comprise the proposed suite, then there must be five versions of Table B-2. One will show the total cost if all instruments are selected as proposed. The other four tables must address the cost of each instrument as if it were proposed separately.

The methodology used to estimate the cost, for example, engineering estimate, specific cost model, past performance, and cost estimating relationships from analogous missions, must be discussed. If an estimate is based on heritage, the performance and cost parameters that the proposed system has in common with the previous system shall be provided. No matter which estimation method is used, sufficient details must be provided in this section and in the technical description of the instrument(s) to allow reviewers to verify the estimate. Budget Reserve Strategy, including budget reserve levels as a function of mission phase, and the reserve level as a percentage of the total cost, must be discussed.

Special Considerations for the Cost Section

1. Full Cost Accounting

NASA civil service labor and supporting NASA Center infrastructure must be costed on a full cost accounting basis. If NASA guidance for full cost accounting has not been fully developed by the closing date for proposal submission, NASA Centers may submit full cost proposals based on the instructions in the NASA Financial Management Manual, Section 9091-5, "Cost Principles for Reimbursable Agreements." If any NASA costs are to be considered as

contributed costs, the contributed item(s) or service must be separately funded by an effort complementary to the proposed investigation and the funding sources must be identified. Other Federal Government elements of proposals must follow their agency cost accounting standards for full cost. If no standards are in effect, the proposers must then follow the Managerial Cost Accounting Standards for the Federal Government as recommended by the Federal Accounting Standards Advisory Board.

2. Goods and/or Services Offered on a No-Exchange-of-Funds Basis

Contributions of any kind, whether cash or noncash (property and services), to MMS investigations by organizations other than the NASA Office of Space Science are welcome. The value of the contributed goods and or services must be entered in the lower part of Table B-2. Values for all contributions of property and services shall be established in accordance with applicable cost principles. Such contributions may be applied to any part or parts of an investigation. For contributions from U.S. organizations, a letter of endorsement that provides evidence that the institution and/or appropriate U.S. Government officials are aware and supportive of the proposed contributions to the investigation and will pursue funding if selected by NASA must be submitted with the proposal. For contributions from non-U.S. organizations, see item 3 below.

The cost of contributed hardware or software should be estimated as either: (1) the cost associated with the development and production of the item if this is the first time the item has been developed and if the mission represents the primary application for which the item was developed; or (2) the cost associated with the reproduction and modification of the item (i.e., any recurring and mission-unique costs) if this is not a first-time development. If an item is being developed primarily for an application other than the one in which it will be used in the proposed investigation, then it may be considered as falling into the second category (with the estimated cost calculated as that associated with the reproduction and modification alone).

The cost of contributed labor and services should be consistent with rates paid for similar work in the offeror's organization. The cost of contributions does not need to include funding spent before the start of the investigation (that is, before completing a contract, grant, or cooperative agreement with NASA). The value of materials and supplies shall be reasonable and shall not exceed the fair market value of the property at the time of the contribution.

3. International Participation and Purchases of Non-U.S. Goods and Services

Participation by non-U.S. individuals and organizations as team members in MMS investigations is welcomed. Participation may include, but is not limited to, the contribution of scientific instruments and/or the contribution of services as a Co-I, and the subsequent sharing of the data from the mission, all on a

no-exchange-of-funds basis. Contributions by international partners must be included in the cost estimate.

Proposers are advised that a contract or subcontract by a U.S. team with a non-U.S. participant using funds derived from NASA must meet all applicable NASA and Federal regulations (see Section 1.3 and Section 5.3). Proposers are further advised that these regulations will place an additional burden on investigation teams that must be explicitly included in discussions of the investigation's cost, schedule, and risk management.

Proposers for non-NASA OSS and also non-U.S. missions must recognize that all such proposals must be consistent, and in compliance, with all U.S. Government laws, regulations, and policies governing the export of hardware and/or technical data. Further, any such successful proposal will require the appropriate agreement(s) and export license(s). A discussion on Compliance with U.S. Export Laws and Regulations must be included in an Appendix to the proposal (see Table B-1, and Section H.7, all in this Appendix). Also, draft language for the technical content of any International Agreements must be provided as part of that Appendix.

The direct purchase of supplies or services that do not constitute research from non-U.S. sources by U.S. award recipients is permitted.

H. APPENDICES

The following additional information is required to be supplied with the proposal as Appendices to the proposal and, as such, will not be counted within the specified page limit. NO OTHER APPENDICES ARE PERMITTED.

1. Resumes. Provide signed resumes or *curriculum vitae* for the PI and Co-I's identified in the science section and named on the Cover Page and Proposal Summary. In addition, provide resumes for all key personnel identified in the Management section and for key E/PO lead personnel. Include data on experience related to the job these personnel will be expected to perform for the proposed investigation. Resumes or *curriculum vitae* must be no longer than two pages in length for each person and should emphasize those experiences, training, and/or publications most relevant to their proposed roles and responsibilities in the proposal.
2. Letters of Endorsement. Letters of endorsement must be provided from all organizations offering contributions of critical goods and/or services (including Co-Investigator services) on a no-exchange-of-funds basis, non-U.S. organizations providing hardware or software to the investigation, and the major participants in the proposal. All letters of endorsement, including those from major participants proposing to be funded by NASA, must specifically endorse the role and/or activities proposed to be undertaken by the participant. Letters of endorsement must be signed by both the lead representative from each organization represented on the team, and, as may be necessary, by institutional or Government officials authorized to commit their organizations to participation in

the proposed investigation. Signed letters of support or commitment must be provided from all E/PO partners or subcontractors detailing their commitment to or involvement in the education and public outreach effort. In the case of science investigators who are providing their time, but not hardware/software or other tangible items, a letter from that investigator only will suffice.

For all U.S. components of proposals offering contributions, letters of endorsement must be submitted with the proposal from both the organization providing any contributed property or service and from the organization providing any required funding. Letters of endorsement must provide evidence that the institution and/or government officials are aware and supportive of the proposed investigation and will pursue funding for the investigation if selected by NASA. They must be signed by institutional and/or government officials authorized to commit their organizations to participation in the proposed investigation.

Letter(s) of endorsement are required for non-U.S. individuals and/or institutions participating as team members and/or as contributions. Requirements for letters of endorsement supporting non-U.S. participation and/or contributions may be found in Section 5.3.

Institutional letters of endorsement for Co-Investigators to be funded by NASA OSS are not required with the proposal but will be required as part of the Phase A concept study report.

Copies of faxed or E-mailed letters from non-U.S. participants may be substituted in the hard copy proposals submitted by the deadline as long as the original signed letters are received by the date specified in the schedule provided in Section 8 of this AO. Endorsements from non-U.S. organizations should clearly identify which proposal is being supported by proposal name and PI name and be submitted to:

Magnetospheric Multiscale Mission (MMS) AO
Office of Space Science
NASA Peer Review Services
Suite 200
500 E Street, SW
Washington, DC 20024 USA

Fax Number: 202-479-9236

3. Statement of Work (SOW). For investigations managed from non-Government institutions, provide a SOW for all potential contracts with NASA. For investigations managed from Government institutions, provide a SOW as if the institution were non-Government. The SOW must include general task statements for Phase A/B/C/D and for Phase E for the investigation. All SOW's must include the following at a minimum: Scope of Work, Deliverables (including science data), and Government Responsibilities (as applicable). SOW's need not be more than a few pages in length.

4. References. Proposals may provide a list of reference documents and materials cited in the proposal. The documents and materials themselves may not be submitted except as a part of the proposal (i.e., within the page limits).
5. Description of Team Member Selection (NASA PI's only). Proposals submitted by NASA employees as Principal Investigators must contain the following information concerning the process by which non-Government participants were included in the proposal. The proposal must (i) indicate that the supplies or services of the proposed non-Government participant(s) are available under an existing NASA contract; (ii) make it clear that the capabilities, products, or services of these participant(s) are sufficiently unique to justify a sole source acquisition; or (iii) describe the open process that was used for selecting proposed team members. While a formal solicitation is not required, the process cited in (iii) above must include at least the following competitive aspects: notice of the opportunity to participate to potential sources, submissions from and/or discussions with potential sources, and objective criteria for selecting team members among interested sources. The proposal must address how the selection of the proposed team members followed the objective criteria and is reasonable from both a technical and cost standpoint. The proposal must also include a representation that the Principal Investigator has examined his/her financial interests in or concerning the proposed team members and has determined that no personal conflict of interest exists. The proposal must provide a certification by a NASA official superior to the Principal Investigator verifying the process for selecting contractors as proposed team members, including the absence of conflicts of interest.
6. Technical Content of Any International Agreement(s). Draft language for the technical content of any International Agreement(s) are required for all non-U.S. partners in an investigation. A sample agreement is available in the MMS online Library (see Appendix C). The draft language should include (i) a brief summary of the mission and the foreign partner's role in it, (ii) a list of NASA's responsibilities within the partnership, and (iii) a list of the non-U.S. partner's responsibilities within the partnership. Note that NASA ordinarily establishes agreements with government funding agencies, not with the institution that will be funded to perform the work.
7. Discussion on Compliance with U.S. Export Laws and Regulations. Investigations that include international participation, either through involvement of non-U.S. nationals and/or involvement of non-U.S. entities must include a section discussing compliance with U.S. export laws and regulations; e.g., 22 CFR 120-130, et seq. and 15 CFR 730-774, et seq., as applicable to the scenario surrounding the particular international participation. Proposers must also comply with NASA FAR Supplement clause 1852.225-70 entitled "Export Licenses." The discussion must describe in detail the proposed international participation and is to include, but not be limited to, whether or not the international participation may require the prospective proposer to obtain the prior approval of the Department of State or the Department of Commerce via a technical assistance agreement or an export license, or whether a license exemption/exception may

apply. If prior approvals via licenses are necessary, the proposal must discuss whether the license has been applied for or, if not, the projected timing of the application and any implications for the schedule. Information regarding U.S. export regulations is available at the World Wide Web addresses given below. Prospective proposers are advised that under U.S. law and regulation, S/C and their specifically designed, modified, or configured systems, components, parts, etc., such as the instrumentation being sought under this AO, are generally considered "Defense Articles" on the United States Munitions List and subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR 120-130, et seq.

Export Control References:

- The International Traffic in Arms Regulations (ITAR) can be found on the web at <http://www.pmdtc.org/reference.htm#ITAR>.
- Specific definitions of defense service, defense article, public domain, and technical data can be found in 22 CFR Part 120 and on the web at http://www.pmdtc.org/docs/ITAR/ITAR_120.txt.
- The U.S. Munitions List (items controlled un the ITAR) can be found in 22 CFR Part 121, and on the web at http://www.pmdtc.org/docs/ITAR/ITAR_121.txt.
- Export Administration Regulations (EAR) that control dual-use commodities and technical data, can be found at 15 CFR Parts 730-774 and on the web at http://w3.access.gpo.gov/bxa/ear/ear_data.html
- NASA Export Control Program can be found on the web at <http://www.hq.nasa.gov/office/codei/nasaecp>.
- The web site of the Department of Commerce Bureau of Export Administration, which administers the EAR, can be found at <http://www.bxa.doc.gov/>.
- The website of the Department of State Office of Defense Trade Controls, which administers the ITAR, can be found at <http://www.pmdtc.org/>

Table B-2. Total Investigation Cost Funding Profile

Costs by FY in Real-Year Dollars, Totals in Real-Year Dollars (RYK\$) and FY 2002 K\$
See Table B-4 for definition of Work Breakdown Structure (WBS) Elements and Table B-5 for
applicable Inflation Index. Costs must include all costs including overhead and G&A. Size of this
table does not count against any page limits in the proposal.

Item	FY03	FY04	FY05	FY06	FY06	Subsequent Fiscal Years		Total (RY \$)	Total (FY02\$)
NASA Cost									
Phase A									
Phase B/C/D:									
WBS 1.0									
WBS 2.0									
WBS 2.1									
WBS 3.0									
WBS 4.0									
WBS 5.0									
WBS 5.1									
WBS 5.2									
.									
.									
WBS 6.0									
WBS 7.0									
WBS 7.1									
WBS 7.2									
WBS 8.0									
WBS 9.0									
WBS 9.1									
WBS 9.2									
WBS 10.0									
WBS 11.0									
WBS 12.0									
Total NASA Cost	\$	\$	\$	\$	\$	\$	\$	\$	\$
Contributions:									
WBS 1.0									
.									
.									
WBS n.0									
.									
.									
Total Contributions	\$	\$	\$	\$	\$	\$	\$	\$	\$
						Total Invest. Cost		\$	\$

Table B-3. Summary of Elements of Costs (see Instructions on next page).

Instrument: _____

For (check one): _____ PHASE A _____ BRIDGE PHASE

	FY03			FY04			FY05			Total		
	Hours	Rate	Cost	Hours	Rate	Cost	Hours	Rate	Cost	Hours	Rate	Cost
Direct Labor												
Labor Hrs/ Costs (by skill categories)		\$	\$		\$	\$		\$	\$		\$	\$
Total Direct Labor Costs		\$	\$		\$	\$		\$	\$		\$	\$
Overhead (by cost centers)		%	\$		%	\$		%	\$		%	\$
Subcontracts			\$			\$			\$			\$
Materials			\$			\$			\$			\$
Material Burdens			\$			\$			\$			\$
Travel			\$			\$			\$			\$
Other Direct Costs			\$			\$			\$			\$
Subtotal			\$			\$			\$			\$
G&A Expense (by cost pools)		%	\$		%	\$		%	\$		%	\$
Subtotal			\$			\$			\$			\$
Cost of Money (by direct pools & overhead centers)		%	\$		%	\$		%	\$		%	\$
Profit/Fee		%	\$		%	\$		%	\$		%	\$
Total Cost Plus Fee			\$			\$			\$			\$

Cost Table Instructions for Table B-3

The Summary of Elements of Cost and Basis of Estimate for Phase A and the Bridge Phase must contain the following direct and indirect elements, as applicable, in real year dollars (document the escalation factors used to determine real year dollars).

DIRECT LABOR HOURS – Show productive hours by individual skill categories.

DIRECT LABOR COSTS – The labor costs must be itemized by skill categories. The basis for the rates should be described.

LABOR OVERHEAD – Overhead must be itemized by overhead cost centers (engineering, manufacturing, etc.), as well as associated rates.

SUBCONTRACTS – Supporting information, such as name/address, cost, fee/profit, basis of estimate, etc., must be provided for each of the major subcontracts.

MATERIALS – Provide supporting details for major vendors. Burden rates must be identified.

TRAVEL – Provide supporting details for destination, purpose, number of people per trip, transportation costs, per diem costs, and miscellaneous costs.

OTHER DIRECT COSTS – Identify cost and purpose.

GENERAL AND ADMINISTRATIVE (G&A) EXPENSE – G&A expense represents the institution's general and executive offices and other miscellaneous expenses related to business. G&A expense must be itemized by cost pool, and rates must be documented.

COST OF MONEY (COM) – COM represents interest on borrowed funds invested in facilities. COM must be itemized by indirect pools and overhead centers, and rates must be documented.

PROFIT/FEE – Document the basis, rate, and amount of all applicable fees for all phases.

Table B-4. WBS Elements.

1. Project management
2. Science Support
 - 2.1 Science Software
 - 2.2 Calibration
3. System engineering
4. Mission Assurance
5. Instrument Suite
 - 5.1 Instrument 1
 - 5.2 Instrument 2
 - 5.3 .
 - 5.4 .
6. Flight Software
7. GSE
 - 7.1 Ground Software
 - 7.2 Ground Hardware
8. Post Delivery Support
9. Science Ops & DA
 - 9.1 Postlaunch Software
 - 9.2 Hardware
10. E/PO
11. Travel
12. Reserves

Table B-5. NASA Inflation Index.

Fiscal Year	2003	2004	2005	2006	2007	2008	2009
Inflation Rate	0.0%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%
Cumulative Inflation Index	1.0	1.031	1.063	1.096	1.130	1.165	1.201

Use an inflation rate of 3.1% for years beyond 2009.

APPENDIX C

BIBLIOGRAPHY OF RELEVANT REPORTS AND RECOMMENDATIONS

The MMS Library includes documents available electronically via the Internet, as well as paper copy. Proposers are requested to access the document electronically where possible. Only limited paper copies of documents are available. Please note that not all documents are available via the MMS Library, but access information is provided.

It is incumbent upon the proposer to ensure that the documents used in proposal preparation are of the date and revision listed in the Announcement of Opportunity or this Appendix.

The MMS Library is accessible on the World Wide Web at <http://mms.larc.nasa.gov/mms>.

Requests for paper copies should be submitted in writing to:

MMS Library
Mail Stop 160
Langley Research Center
National Aeronautics and Space Administration
Hampton, VA 23681-0001

Fax Number: (757) 864-8894
E-mail: c.l.daniels@larc.nasa.gov

Office of Space Science Strategies and Policies

The Space Science Enterprise Strategic Plan (November 2000)

(<http://spacescience.nasa.gov/admin/pubs/strategy/2000/index.html>)

This document is a concise statement of the goals and outlook of NASA's Space Science Enterprise.

Implementing the Office of Space Science (OSS) Education/Public Outreach Strategy

(October 1996) (http://spacescience.nasa.gov/admin/pubs/edu/imp_plan.htm)

This document describes OSS's overall approach to implementing its Education/Public Outreach strategy.

Office of Space Science Education and Public Outreach FY2001 Annual Report (May 2002) (<http://ossim.hq.nasa.gov/ossepo/>)

As a consequence of the policies adopted by OSS, a major, national space science E/PO program is now underway, as reported in the above document.

Explanatory Guide to the NASA Office of Space Science Education & Public Outreach Evaluation Criteria (February 2002)

(http://ssibroker.colorado.edu/Broker/Eval_criteria/Guide)

Partners in Education: A Strategy for Integrating Education and Public Outreach into NASA's Space Science Programs (March 1995).

(<http://spacescience.nasa.gov/admin/pubs/edu/educov.htm>)

This document describes the overall strategy for integrating education and public outreach into NASA's space science programs.

Additional information on the EPO program on the Office of Space Science can be found at <http://spacescience.nasa.gov/education/index.htm>

The Space Science Enterprise Integrated Technology Strategy (October 1998).

(<http://spacescience.nasa.gov/admin/pubs/sse/>)

Describes efforts to manage technology infusion into future OSS missions and to promote technology transfer to the private sector

Science Definition Teams

Geospace Multiprobes, Report from the Science Definition Team (December 1997).

(http://stp.gsfc.nasa.gov/missions/mms/geospace_multiprobes_report.htm)

A Geospace Multiprobe Science Definition Team developed a report that describes three multiprobe missions that could provide the first giant steps to understanding how the geospace system processes the energy and mass flow that are delivered to it and how that is redistributed within the system is accomplished.

The Magnetospheric Multiscale Mission . Resolving Fundamental Processes in Space Plasmas (December 1999).

(http://stp.gsfc.nasa.gov/missions/mms/mms_STDT_report.htm)

The Magnetospheric Multiscale Mission Science and Technology Definition Team have published the results of their studies on the MMS mission in this report.

Space Science Roadmaps

Sun-Earth Connection Roadmap 2003 - 2028, Understand how the Sun, Heliosphere, and the Planetary Environments are Connected in a Single System (September 2002)

(http://sec.gsfc.nasa.gov/sec_roadmap.htm)

The Space Science Advisory Committee and its subcommittees have developed Roadmaps, planning documents that prioritize the space science goals for NASA for the years 2003 - 2028

The Sun to Earth - and Beyond, A Decadal Research Strategy in Solar and Space Physics (2002)

(<http://www.nationalacademies.org/ssb/sspsuntoearth.html>)

A National Research Council approved study to assess the current status and future directions of U.S. ground- and space-based programs in solar and space physics research.

MMS and STP Guidelines and Requirements Documents

These documents are available on the World Wide Web MMS Library at <http://mms.larc.nasa.gov/mms>.

ISST Proposal Checklist

MMS Instrument Mission Assurance Requirements (MAR)

MMS Work Breakdown Structure and Definitions

MMS Guidelines and Criteria for the MMS Phase A Concept Study

MMS AO Acronyms List

General Environmental Verification Specification (GEVS) Payloads, Subsystems, and Components, Revision A

Example Instrument Statement of Work (STEREO, PLASTIC)

Example LOA (STEREO – ESA)

Model Phase B-E Contracts, including the Example Deliverables List

STP/LWS E/PO Program Overview

General Guideline and Requirements Documents

Links to these documents are available on the World Wide Web MMS Library at <http://mms.larc.nasa.gov/mms>.

NPG 7120. 5A—NASA Program and Project Management Processes and Requirements (April 1998)

This document provides a reference for typical activities, milestones, and products in the development and execution of NASA missions.

Space Science Enterprise Management Handbook. Discusses the confirmation review process for Phase A to B Transition (section 7.3) and Phase B to C Transition (section 7.4)

NASA Independent Assessment Team (NIAT) Report (2000)
Report of the NASA Independent Assessment Team.

ISO 9000 Series

The following ISO 9000 quality documents describe current national and NASA standards of quality processes and procedures.

ISO 9000:2000, Quality Management Systems – Fundamentals and Vocabulary

ISO 9001:2000, Quality Management Systems - Requirements

ISO 9004:2000, Quality Management Systems - Guidelines for Performance Improvements

Note: The above ISO 9000-related documents are copyrighted and cannot be reproduced without appropriate compensation. For copies contact:

American Society for Quality (ASQ)
P. O. Box 3005
Milwaukee, WI 53201-3005
Ph: 1-800-248-1946
<http://www.asq.org/>

For background on NASA ISO policy and the status of its implementation, visit <http://iso9000.nasa.gov/>

Procurement-related Information

Links to these documents are available on the World Wide Web MMS Library at <http://mms.larc.nasa.gov/mms>.

Federal Acquisition Regulations (FAR) General Services Administration

NASA FAR Supplement Regulations

NASA Financial Management Manual

NPG 5800.1—Grant and Cooperative Agreement Handbook (October 2000)

Other

Links to these documents are available on the World Wide Web MMS Library at <http://mms.larc.nasa.gov/mms>.

NASA Technology Database

Technology Readiness Level (TRL) Definition Chart

Example Mission Definition and Requirements Agreement

APPENDIX D

CERTIFICATIONS

These certifications are included for reference only. Submissions of the signed printout of the web page as directed for the Cover Page/Proposal Summary certifies compliance with these certifications.

1.0 Assurance of Compliance with the National Aeronautics and Space Administration Regulations Pursuant to Nondiscrimination in Federally Assisted Programs

The (Institution or organization on whose behalf this assurance is signed, hereinafter called "Applicant.")

HEREBY AGREES THAT it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352), Title IX of the Education Amendments of 1972 (20 U.S.C. 1680 et seq.), Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and the Age Discrimination Act of 1975 (42 U.S.C. 16101 et seq.), and all requirements imposed by or pursuant to the Regulation of the National Aeronautics and Space Administration (14 CFR Part 1250) (hereinafter called "NASA") issued pursuant to these laws, to the end that, in accordance with these laws and regulations, no person in the United States shall, on the basis of race, color, national origin, sex, handicapped condition, or age be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Applicant receives Federal financial assistance from NASA; and HEREBY GIVES ASSURANCE THAT it will immediately take any measure necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the Applicant by NASA, this assurance shall obligate the Applicant, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the Applicant for the period during which it retains ownership or possession of the property. In all other cases, this assurance shall obligate the Applicant for the period during which the Federal financial assistance is extended to it by NASA.

THIS ASSURANCE is given in consideration of and for the purpose of obtaining any and all Federal grants, loans, contract, property, discounts or other Federal financial assistance extended after the date hereof to the Applicant by NASA, including installment payments after such date on account of applications for Federal financial assistance which were approved before such date. The Applicant recognizes and agrees that such Federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to

seek judicial enforcement of this assurance. This assurance is binding on the Applicant, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign on behalf of the Applicant.

2.0 Certification Regarding Debarment, Suspension, and Other Responsibility Matters Primary Covered Transactions

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 14 CFR Part 1265.

A. The applicant certifies that it and its principals:

- (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
- (b) Have not within a three-year period preceding this application been convicted or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or Local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
- (c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph A. (b) of this certification;
- (d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or Local) terminated for cause or default; and

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

C. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion—Lowered Tier Covered Transactions (Subgrants or Subcontracts)

- (a) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principles is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department of agency.
- (b) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

3.0 Certification Regarding Lobbying

As required by S 1352 Title 31 of the U. S. Code for persons entering into a grant or cooperative agreement over \$100,000, the applicant certifies that:

- (a) No Federal appropriated funds have been paid or will be paid by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, in connection with making of any Federal grant, the entering into of any cooperative, and the extension, continuation, renewal, amendment, or modification of any Federal grant or cooperative agreement;
- (b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting an officer or employee of any agency, Member of Congress, or an employee of a Member of Congress in connection with this Federal grant or cooperative agreement, the undersigned shall complete Standard Form—LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
- (c) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subgrants, contracts under grants and cooperative agreements, and subcontracts), and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by S1352, title 31, U. S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.